PROCEEDINGS

Forty-Seventh Annual Convention

OF THE

American Railway Bridge and Building Association

1940

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A. E. Bechtelheimer
President, 1940

Proceedings of the

Forty-Seventh Annual Convention

OF THE

American Railway Bridge and Building Association

Held at

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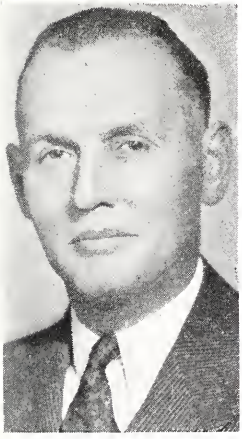

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1941 CONVENTION

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PROCEEDINGS

MINUTES AND ADDRESS

OPENING SESSION

Tuesday, Oct. 15, 1940

THE Forty-Seventh annual convention of the American Railway Bridge and Building Association, held in the basement convention room of the Stevens Hotel, Chicago, was called to order at 10:20 a. m. on October 15, 1940, President A. E. Bechtelheimer, assistant bridge engineer, Chicago & North Western, presiding.

President Bechtelheimer: Members and Guests, I am glad to welcome you to our opening session this morning.

We will now open the Forty-Seventh annual convention of the American Railway Bridge and Building Association.

In compliance with our by-laws, and following the dictates of our hearts, let us pause for a moment to ask for divine guidance in our deliberations. We will be led by the Rev. Walter Henry Nugent, Pastor of the Austin Presbyterian Church, whose church was very dear to the heart of our late secretary, Calvin A. Lichty.

(Reverend Nugent delivered the invocation while heads were bowed in silence.)

President Bechtelheimer: The opening address of our convention will be made by C. E. Johnston, Chairman of the Western Association of Railway Executives, Chicago. Many things can be said of Mr. Johnston. He began his railroad career at the age of 14, as a call boy, and 33 years later became president of the Kansas City Southern Railway. He educated himself as an engineer and a railroad manager along the way. His career led him through the engineering department. He knows railroading, and he knows railroad men and their problems.

Mr. Johnston has been a member of this association for 29 years, and addressed our opening session on a previous occasion. I am sure that our recollection of what he said at that time makes us happy that he is to bring us a message again at this opening session. I present to you Mr. Johnston.

For the convenience of those using this volume, it is divided into two parts, one beginning with this page, presenting a running report of the convention, with suitable page references to the second part, which groups together the committee reports and various technical addresses.

Address of Welcome

By C. E. Johnston
Chairman, Western Association of Railway Executives

C. E. Johnston

I am happy to be with you and to welcome you to Chicago. Although Chicago is a very large city, it is not too large to take note of and to appreciate that you individually, and your association, come here in annual meetings not only for the trip, but for a real serious purpose; and we join you in the hope that this meeting will be most successful.

Your association, like others similarly organized, is justified only so long as its purposes are fully realized. You, individually and collectively, are directly responsible for the results. You seek information and you give information through a free and full exchange of views and experiences regarding the various subjects under discussion. In that way, all get help and inspiration to carry on better the jobs assigned to them. I feel confident that you will take advantage of the golden opportunity to make this convention one of the best, if not the best, your association has ever held.

As a youngster, starting out for myself, I joined the engineering department of a Chicago railroad, and within the first couple of years I experienced my first real impression of bridge building, and the absolute necessity for care and precision which it involves. This important lesson was never forgotten. We were engaged in building an extension of a line near the Mississippi river, in southeast Missouri. The extension was 16 miles long, the greater part of which was in what was called "Nigger Wool" swamp, where many relief openings were necessary to provide for overflows from the Mississippi river. The entire extension was under one small engineering party of which I was a member, and when it was completely covered by contractors, naturally, we were struggling to keep up with the work.

I had been taught to run a level, so, one day I took an axeman and undertook to set points of cut-off for the piling at one of the relief openings. In those days, the old-style drop-hammer drivers were still in use. I proceeded to do my "stuff," and when all of the tacks for cut-off had been set, the bridge gang started sawing. There was a light grade over this bridge, and, while I had figured the elevations correctly for each bent, I simply started at the wrong end of the bridge to apply the change in grade per bent, with the result that some three or four bents were cut off with the grade running in the wrong direction.

I was greatly chagrined at the mistake I had made. Fortunately, the error was discovered early, or

before any serious damage was done, and, by the use of a few shims, everything was fixed up. But the experience was most valuable to me in later years. After all, I am a believer in the old adage, "Experience is the best teacher," and that the "School of Experience," like many "horse and buggy" philosophies, is still good.

Where Are We Drifting?

I recite this experience as a prelude to comments on the most important subject of human relations, which, at this time in particular, deserves our serious consideration. I mentioned "horse and buggy" philosophies in connection with the School of Experience. We all know that times have changed and are continuing to change, and, no doubt, all of us have paused to wonder, whither are we drifting? We are living in an altogether different world today, as compared with 25 or 30 years ago. We seem to have graduated out of the "horse and buggy" days into something else, and we exert great effort to keep abreast of the ever-changing times.

This does not mean—this cannot mean, that we are to substitute fundamentals, which will change entirely the American way of life, without jeopardizing our very liberty and freedom. Both you and I know the liberties and the freedom that we enjoy in this country. We have experienced nothing else. But are we failing utterly to appreciate the multitude of advantages in a republic? We all know well that we do not long get something for nothing; that we cannot spend ourselves out of debt; and that we cannot expect much unless we work for it. Still, we sit complacently by day after day and watch our politicians operate in a fashion that cannot but ultimately cause a serious change in, if not wholly destroy, our American way of life as handed down by our forefathers. We, therefore, must consider what we are to hand down to our children and our children's children.

No "Hats" in Pile Driver Crew

Many years ago we had a serious washout of our main track in the Neches river bottom in East Texas. I was chief engineer at the time and in charge of the repair and replacement work. When I arrived on the scene with the repair forces, materials and equipment, including one pile driver, I found that we needed another pile driver to operate on the opposite side of the break.

Therefore, I made arrangements to borrow a driver and crew from a neighboring line which, on account of the urgency of the situation, made a hurried selection of men. When this outfit came, I went across the overflow in a boat and met the pile driver foreman. About the first question I asked him was, "How many men have you?" His answer was, "Six men and 15 hats." You know and I knew what he meant, but at that particular time we were happy to get even "hats." My point is that today there are too many "hats"—that we must throw together our wits and figure out some way to improve the situation.

It has been my experience that one of the places where you do not find "hats" is in a pile driver crew—where men are almost super-men by the very reason of their arduous duties.

I recall another instance which is typical of a thoroughly good pile-driver outfit. It happened at Kansas

City, about 1915. The Missouri river was on a rampage and weather reports indicated the water level would reach flood stage the following morning. In that event, our East Bottom train yard would be flooded. We desired to avoid that if possible because of the delay that would result to trains, and also because of the cost that would be involved to remove the mud deposit, and otherwise clean the yard, after the water had receded.

We decided to undertake the building of a dike out of sand bags, thinking that if the river rose slowly we might keep up with it; recognizing, however, that as the water rose, both the length and height of our dike would be increased. I knew we were taking on quite a chore, but decided to take the long chance of its being successful. At the time, we had a pile-driver outfit in our Kansas City yards, so I went down and conferred with the foreman, who, by the way, was a member of this association and who attended many of its annual meetings. He passed on a few years ago. I told him what I had in mind and asked him what he thought of it. He replied —"Well, we haven't done anything until we have tried, so let's go." We organized two or three Greek extra gangs, with his pile-driver crew to direct them, and with a train of sacks and sand started in, about three o'clock in the afternoon, to fight the Missouri river. We fought that river for 12 hours, and until it overpowered us by reaching a height much greater than was necessary to submerge our yard. We did get a lot of satisfaction out of the effort, however, because of the attitude and fighting spirit of our men, who had about as much fight in them at the finish as they had had when they started. And it's that fighting spirit that we seem to lack these days, and that we must constantly strive to regain.

Perhaps we have had some reason for a defeatist attitude during certain years of the depression period since 1929, but this country wasn't built upon defeatism, nor were our railroads built and improved by defeatists. I have singled out a typical pile-driver crew in the bridge and building department of our railroads to show that we are not all defeatists, because my experience has been that these small organizations generally exemplify the true American spirit of initiative and freedom, which, when properly organized, is capable of producing great accomplishments. In fact, there appears to be no limitation on achievements where this spirit prevails.

Socialistic Trends

Look at the other side of the picture. The socialistic trend—people willing to let our government take care of them and their dependents —and we now have plenty in this class. Sometimes I fear it is almost the majority. With this, we seem to have a government that is perfectly willing, for political purposes mainly, to deal out free money for work not performed, for crops not raised, and for political purposes otherwise. With an appalling public debt that continues to mount, what more or better results are we to expect from the rank and file who take no more than a passive interest in such matters, unless we are able, intelligently and honestly, to impress them with the great risk involved.

The risk involved is, in plain terms, the loss to all of us of our

very liberty and freedom. We have heard and know enough of what has happened in Europe to convince us thoroughly that our basic form of government, which this generation has always enjoyed, is the best on earth. We know also that to keep what we have requires more interest and effort than we are putting forth, especially at this time, when war has almost surrounded us and our republic is in the balance.

This leads me into the subject of our relationship with labor. By labor, I mean employees of all classes. I may go further and include officers and employees, because officers generally are promoted employees who started at the bottom of the ladder. The extent of the unity between these forces, both in organization and in purpose, spells success or failure, profit or loss, peace or turmoil.

Railroading is a simple operation of work and thought, the same as may be said of industries in other fields, built up over the years under the American system of free enterprise. We are employed in an industry that is essential and that is operated for the common good.

Sad to relate, we have those in our ranks who, by their acts or sympathies with outside forces, seek, knowingly or otherwise, to destroy the fundamentals of free enterprise. This is disloyalty in its worst form, not only to our industry, but to our republic. We cannot blame a large percentage of these individuals because, I am sure they do not realize the true effect of their action or attitude. They are influenced by leaders whose purpose is selfish, and to gain power politically.

Organized labor, in its true sense, means organization for mutual cooperative benefit. We certainly have no quarrel about collective bargaining. We agree that labor should have every consideration in the way of satisfactory working conditions and rates of pay. As a matter of fact, we spend much time and thought to bring about all of these advantages in favor of labor. We are, however, strongly opposed to the operation of labor unions for the benefit of unscrupulous racketeers who promote strife in their own self interest, at the expense of their members. We have seen much of this sort of thing during the last ten years of depression, and its correction is truly a part of any program involving the recovery of America to the place our forefathers intended.

Government Ownership

We are confronted constantly with the threat of government ownership and operation of our railroads. Both you and I know the results of such control and operation. We had that experience during the first World War approximately 20 years ago, and now we find a strong political faction, including certain labor unions, favoring its return. Why? We think we know the answer to that question.

We need not look far to see the present-day effect of railroad management by government and labor unions. It exists now near home —just across the Rio Grande, in Mexico.

In 1937, the Mexican government expropriated the National Railways of Mexico and turned its management over to the labor unions. This railroad has a mileage of approximately 8,400 miles—about 60 per cent of the total mileage in Mexico. The reason given for that action on the part of the

Mexican government was the deterioration of service and financial condition. It should be noted, however, that this condition was due to lack of discipline and to constant pressure for new concessions by the unions. For 17 years prior to 1937, the railways were operated nominally by the Company's management, under an administrator appointed by the president of the republic. This made them largely a political machine.

The significant feature is that the rank and file of the unions continue to regard their own administrator as an employer, from whom every possible concession must be wrung, and, apparently, they have no interest in the success of the enterprise, either as to service or finances. Notwithstanding the fact that the Mexican government owns the railroad, which I assume means no payment of taxes or interest on investment, the total deficit from operations alone for less than the three-year period to February 15, 1940, which must be paid out of the public treasury, was 23,000,000 pesos (approximately $4,700,000).

Mexican Situation Serious

This bring home to us what could happen here in the United States under government ownership. Even if the management were not turned over directly to the labor unions, the administration would most likely be political, and with similar results as to deficits of operation. The experience on the National Railways of Mexico checks what actually happened here during the period of Federal control, ending March 1, 1920.

The situation in Mexico finally reached the point where President Cardenas, favorable as he was to the socialization program pursued so vigorously by his administration, could not but regard with dismay the serious situation of the Mexican Railways under the management of the railway unions. Therefore, he forwarded a memorandum to the union demanding the following measures:

(1) Immediate steps to better the financial condition of the lines through the reduction in operating costs and the elimination of waste.

(2) Vacancies created by the withdrawal or death of workers should not be replaced where the jobs were not indispensable, to remedy the condition of excessive personnel which is the inevitable accompaniment of government or cooperative enterprise in Mexico.

(3) Modification of those clauses of the labor contract on the railways which have been found to be unjustified or unduly burdensome.

(4) Increased efficiency and better service.

The general manager of the Labor administration of the railway lines warned, in a circular, that if these essential steps were not taken soon, the Federal government would resume direct operation of the lines. He said wage reductions of 1,800,000 pesos monthly (approximately $365,000 monthly, or $4,380,000 annually) were necessary to save the lines from "financial chaos."

I have outlined briefly what has happened and is happening to the railroad industry in Mexico. It seems obvious that such a situation comes from too much government in business, unlimited power of the politicians, and unscrupu-

lous labor racketeering. We need not look beyond the limits of the United States to find similar situations. Perhaps not in the railroad field to the same extent, but in other fields. Mexico has no corner on socialism. We have plenty of it here, and, unfortunately, we have much of it in our politics.

Our railroad system was built upon the foundation of freedom, under one "ism"—and that is, "Americanism." We cannot understand, nor do we desire to understand, the meaning of all the other "isms" when applied to America.

I dare not leave this subject without pointing out to you another most important angle to the labor problem. We, as supervisors in the railroad field, in dealing with our employees, must never overlook our clear duty to deal with labor on an absolutely fair and sympathetic basis. We must, at all times, recognize sincerity of purpose and conscientious effort, and extend to our men and to their loved ones, that measure of human sympathy which will encourage and merit their loyalty, and, so far as possible, insure to them regular employment under the best possible conditions. This done, we may reasonably expect a fair measure of return in loyalty and effort which, in itself, brings harmony and best results.

Tribute to C. S. Heritage

In closing, I wish to pay tribute to Past-President Carl S. Heritage, who passed away at Kansas City, Mo., on August 31 last, after a long illness. Mr. Heritage was a member of our association for many years, and for several years served as an officer. His obituary appears in the July - August - September, 1940, issue of the B. & B. News.

I may rightfully claim Carl as one of my boys, although we were about the same age. He came to the Kansas City Southern about the time I was appointed chief engineer. He worked as a bridge draftsman for a few years and then, in 1915, was promoted to bridge engineer, which position he held at the time of his death.

In this man were all the characteristics of a true American. Educated as an engineer, he was unselfish, conscientious, capable, friendly and kindly to all, helpful to all, and loyal to his employer, his friends and his country. This association, his railroad, his community and his country lost a real man in his passing.

Gentlemen of the American Railway Bridge and Building Association, you will do well to encourage men like Carl Heritage to become members of this association. You cannot go wrong in your policy of selecting men of such high type as your officers, and certainly you will gain, and our industry will gain, in following the advice and counsel of such men.

President Bechtelheimer: Mr. Johnston, I know I express the feelings of everyone in this room when I say, thank you for your inspiring address. We are grateful to you for coming here this morning. You have told us many things to take home, to think over, and to profit by.

The American Railway Engineering Association is the leader in the field of railway engineering because it is composed largely of railway men who formulate our railway engineering practices. A.R.E.A. specifications covering design, materials and workmanship are in general use on most of the railways of the North American

continent. Our bridge and building work conforms to standards of their making. Hence there is a close relationship between the A.R.E.A. and the American Railway Bridge and Building Association and we are happy that we enjoy its friendship and good wishes.

Its president, Geo. S. Fanning, is here to bring us greetings from its members. Mr. Fanning, besides being president of the A.R.E.A., is chief engineer of the Erie Railroad. I present Mr. Fanning.

Greetings from the American Railway Engineering Association

By Geo. S. Fanning, President

I am very happy to come today as a representative of the American Railway Engineering Association to bring you our greetings and to express to you our great happiness in the years of association which the Engineering association has had with yours.

The American Railway Engineering Association is composed of engineers in all phases of railway work, including track, bridges, structures, water stations, roadway, rail, etc. Your association is a specialized one, dealing with bridges and buildings, and through it you do something that needs to be done in that you bring the engineers into close fellowship with what I might call the "artisans"—the supervisors, master carpenters, foremen, and master masons; all meet here under your auspices to discuss their common problems.

I should like to talk particularly to those of you who are not engineers. The engineers have heard me many times. We engineers appreciate the loyal support and cooperation that we get from supervisors and foremen. We lean on you, and we lean very heavily.

Your organization has been in existence 47 years—longer than ours—and there is every reason why this should be so, because long before there were engineers there were artisans and master masons. Back in the medieval days, wonderful viaducts and beautiful cathedrals were built—not by engineers and architects, but by master masons— men who were the forerunners of the group included in your association today. Some of our most interesting engineering structures and engineering features of such structures, such as arches, were conceived, not by engineers and architects, but by masons. And a wonderful job they did.

Some of the most beautiful arches — for instance, the Gothic arch—arose from the efforts of a mason to simplify the construction of arches. It was a bit difficult to employ where he had openings of varying size to span, because he could not always get a full circle. But he could cut stone to a circle, and he figured that if he used two segments of circles meeting at a point he could always cut the stone. It had other advantages. For waterway openings, it gave more waterway above the spring line; it put more load on the haunches to offset the springing effect of the arch.

He did not know it in those terms, but he knew that he was accomplishing the desired results. Inasmuch as he had to build all of his arches so that each of them was self-supporting, the Gothic arch was well suited, because it produced the least side-thrust on the piers. As a result, he made something that we think of as one of the most beautiful things in the world, while not looking especially for beauty, but rather first for service, strength and durability. He built for the ages. While doing that, he achieved beauty.

That is an example of some of the things that the engineers owe to the artisans, and I am here to thank you on behalf of the engineers for what you have done. That is one phase of what I should like to say to you.

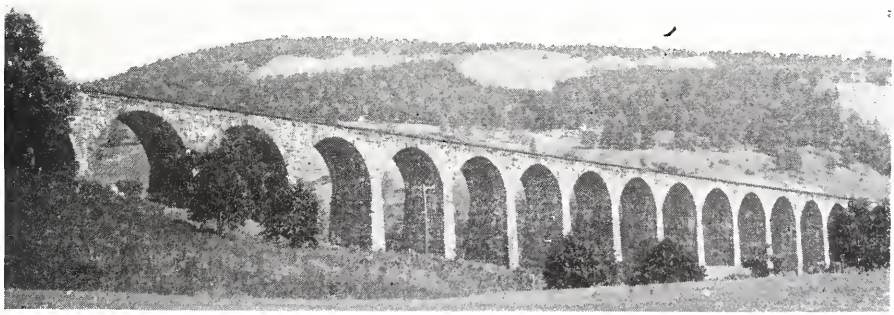
The other is, that a bridge is something which, in itself, is nothing, except as it carries a road—a railroad or a highway. And a road, in itself, is nothing except as it carries traffic—human traffic. And the roads—the highways and the railroads — throughout the ages, have been the means of communication between the different areas of the world and have really been the foundation upon which has been built the civilization that we have today.

So I urge you to give due consideration to what Mr. Johnston has said. To expand your thoughts beyond the bridge; first, to the railroads as a whole; and second, to the problems of civilization today.

President Bechtelheimer: Mr. Fanning, I thank you in the name of the Bridge and Building Association for meeting with us this morning and bringing us greetings from the large group of engineers composing the A.R.E.A.

The Roadmasters' and Maintenance of Way Association and the B. & B. Association have been closely associated in railway work for nearly 50 years. I do not know that there has been an exchange of greetings between these associations each year over this long period of time, but there has always been close co-operation and understanding between us.

J. J. Clutz, president of the Roadmasters' and Maintenance of Way Association is here this morning to bring greetings from that association. Mr. Clutz is division engineer on the Pennsylvania Railroad at Indianapolis, Indiana.



Starrucca Viaduct, On the Erie, Which is Nearly 100 Years Old, and Carrying Present-Day Main-Line Traffic, is a Splendid Example of Old Stone Masonry Construction.

Greetings from the Roadmasters' and Maintenance of Way Association

By J. J. Clutz, President

It is a real pleasure for me to bring to this, the Forty-Seventh Annual Convention of the American Railway Bridge and Building Association, the greetings and good wishes of the Roadmasters' and Maintenance of Way Association of America.

As your president has said, these two associations have been closely affiliated throughout their lives—nearly 50 years. They have a common objective—to meet and discuss questions pertaining to their respective, but closely related, fields, and to raise the standards of work committed to the charge of their members.

The right to assemble freely and to discuss openly questions of common interest is a precious heritage, a right which now exists in few other countries of the world; but, like the right to vote, this privilege is of little value unless it is exercised. Associations such as ours perform a useful service only as the members take an active part in their work, particularly in the discussions from the floor. Through a free discussion of committee reports and other subjects which may arise, ideas are communicated to others which otherwise remain locked up in one man's mind; facts, based on experience, are shared and everyone benefits. Thus, the objective of the association is realized, and one goes back to his job stimulated in mind, refreshed in ideas, better able to carry on his work efficiently because of what he has learned.

I am looking forward keenly to this convention. I am a "baby" member of the association. This is the first convention that I have had the privilege to attend. I am looking forward to a free and open discussion so that I will benefit and, when you take part in the discussion you benefit as well.

I was talking to one of your past presidents this morning—John P. Wood. He was speaking of the hard work that is involved in carrying on the leadership of this association for a year, at the same time he said that one benefits far more than the effort he puts into it, not only in what he learns, but also in the friendships he makes. That is true not only of the officers of the association, but also of each one of you individually. By taking an active part and making friends, you will carry back much of permanent value.

Again, I bring to you best wishes from the Roadmasters' and Maintenance of Way Association for a highly successful convention.

President Bechtelheimer: Mr. Clutz, we accept your kind greetings and in return bespeak for you a most successful year in the administration of the affairs of the Roadmasters' and Maintenance of Way Association.

Our affiliate organization, the Bridge and Building Supply Men's Association, has held meetings concurrently with our association conventions for many years. We are indebted to this association for the exhibits being staged in the space

outside this room. It has also made arrangements for the Annual dinner on Wednesday evening, and for the entertainment of the ladies at our convention. Harry Wolfe, railroad representative of the Lehon Company of Chicago, who is president of this association, is here this morning to bring us greetings from his association.

Greetings from the Bridge and Building Supply Men's Association

By H. A. Wolfe, President

To the greetings from the American Railway Engineering Association and the Roadmasters' and Maintenance of Way Association, I should like to add a hearty welcome from your affiliate, the Bridge and Building Supply Men's Association. I appreciate the privilege of addressing you in behalf of our association. Our two groups are meeting again today in a common cause—the cause of promoting greater efficiency in the maintenance of railway bridges and buildings.

The manufacturers who are exhibiting at your convention have gone to considerable trouble and expense to make their exhibits worth while. I want to take this opportunity to urge all of you to visit each one of us, to renew old acquaintances and to meet all of our representatives who are here. They are all anxious to tell you about their products. As the saying goes, "the latchstring is always out."

President Bechtelheimer: Thank you, Mr. Wolfe for your greetings and for the interest of your group in this association.

Past Presidents Introduced

At this time I want to introduce the gentlemen on the platform; our past presidents L. D. Hadwen, 1914-15; George W. Rear, 1915-16; Fred E. Weise, 1919-20; J. P. Wood, 1924-25; Elmer T. Howson, 1926-27; T. H. Strate, 1935-36; E. C. Neville, 1936-37; and C. M. Burpee, 1937-38: also our vice-presidents H. M. Church, R. E. Dove and F. H. Soothill.

I will now introduce F. O. Whiteman, who, on June 8, was elected by the Executive committee to serve as secretary of this association. Mr. Whiteman is also secretary of the Roadmasters' and the Superintendents' Associations.

It gives me pleasure also to reintroduce a man who has served in every office of this association and who is now starting on his second round. Fred E. Weise has been our treasurer since June 8 of this year. He was treasurer in 1914 and 1915; a director in 1915 and 1916; vice-president in 1916 and 1917; and president in 1919 and 1920. He is the leader of our membership from the Chicago, Milwaukee, St. Paul and Pacific.

President Bechtelheimer's Address

It is a pleasure to welcome you to our Forty-Seventh Annual Convention, which closes another year of association activity—a year in which several noteworthy things have taken place that have been of great help in our work.

I desire to call some of these things to your attention. Our relations with the American Railway Engineering Association and the Roadmasters' and Maintenance of Way Association have been cordial and productive of a better understanding of the work of each group. Mr. Fanning, president of the American Railway Engineering Association, has brought us greetings in an inspiring address, full of thoughtful comments of value to all of us. This year I, as president of the Bridge and Building Association, was a guest at the A.R.E.A. President's dinner which preceded the opening of their annual convention last March. Three A.R.E.A. committees are holding meetings in Chicago at this time, thus affording their members the opportunity of attending some of our sessions. Some of them are here this morning.

Mr. Clutz, president of the Roadmasters' and Maintenance of Way Association, likewise has brought us greetings from that Association in a very friendly manner. Their Executive committee met in joint session with our Executive committee June 8 last and elected F. O. Whiteman to the secretaryship of each association. Greetings from our association were extended to that group at the opening of their convention in this room on Sept. 10.

We are grateful to the A.R.E.A. and the Roadmasters' Association for these manifestations of good will.

Good Relations With Management

Our relations with railway managements have brought to us a better understanding of their attitude with respect to association work. Executive officers of many roads have disclosed a very keen and kindly interest in the work that we are doing and have shown that they recognize that conscientious effort on our part in the study and solution of our problems will be of great benefit to us and to the railways. It is my opinion that this friendly spirit of encouragement and co-operation will continue so long as we are able to show by our earnest attention to these matters that we can accomplish things of real value to ourselves and to the railways which we represent. This convention, which is the high point in the year's work of our association, expresses in concrete form our purpose to do that very thing, and by so doing, to bring vital, worthwhile information to men interested in railway and bridge building problems.

I advise you, therefore, to apply every minute of the time while you are here to the work before us. Be prompt in attendance at all of the sessions; be helpful by joining in the discussions; study the reports that have been made available to you in most convenient form; and make notes for use in the discussions so that our program will proceed expeditiously.

You should visit with old friends and make new ones; you are here for stimulation, for education, for acquaintance and for inspiration—so, make the most of it. Spend as much time as you possibly can studying the exhibits of the Bridge and Building Supplymen's Association.

Executive Committee Meetings

The Executive committee of your association held a number of meetings during the year. The first was on October 19, at the close of the 1939 convention, at which time the following committees were appointed: Publication, Hotel and Arrangements, and Membership. The committee met again on October 31. The next meeting was held January 13 to outline the scope of work for the investigating committees and to select the personnel of these committees from the volunteers and the membership at large. On June 8 a joint meeting was held with a similar group from the Roadmasters' association to elect a secretary for both of the associations. At this meeting, the Bridge and Building Executive committee also elected a treasurer. Both of these elections were to fill a vacancy in these offices. At the meeting held July 15 committee chairmen were present and presented preliminary drafts of their committee reports, which were read and discussed. Plans for this convention were also formulated at that meeting.

Many informal group meetings were held throughout the year. You should know that the business of the association requires constant attention throughout the year. Informal meetings of officers and past-presidents residing in the Chicago area are called frequently to keep the business of the association running as smoothly as possible. The advice and counsel of our past presidents are invaluable to the president and secretary of this association.

Publication Committee

The Publication committee has functioned efficiently and, aided by the secretary, four issues of the bulletin were sent out. These issues totaled 3,500 copies. The purpose of these bulletins is to keep you posted on the news and other current association matters of general interest to all members. A new feature was started in the first-quarter issue of 1940, called "Are We Making Good?" Lack of space in subsequent issues necessitated withholding this feature. It will appear in later issues as space permits. I suggest you be on the lookout for it. A total of 3,000 special letters have been sent out over the president's signature during the year, and I feel that you have acknowledged these letters by being present here this morning.

In many respects we have fallen far short of the goal set at the beginning of the year. Our membership drive got off to a good start and then floundered, with the result that only 40 men have joined the association since our last convention. I shall take only a part of the blame for this situation, and lay the rest of it upon your shoulders, because I feel that you have not been sufficiently active in this matter. If the association is of benefit to you, then it will be of benefit to other men whom you can contact. You should see that they know of these things, for we must have new men—younger men—to replace those going out at the top.

This matter is referred to you as something which each member must deal with personally.

Some Behind in Dues

Another shortcoming which has distressed the association during the year is the oversight, or otherwise, of those who have been remiss in the payment of their dues. A determined effort was made to correct this situation, but, because of indifference on the part of those concerned, very little was accomplished. This is a matter requiring serious consideration on the part of every member of this association. A considerable amount of the secretary's time and considerable expense to the association could be saved for constructive work if dues were paid promptly. The association has two sources of income—dues paid by members and revenues from advertising in the Proceedings. Returns from the latter source are not large. The membership dues must carry the load. A report of our financial condition will be presented later.

During the year we have had notice of the death of eight members. Our secretary-treasurer, Cal Lichty, whose death occurred on April 18, had been a member of this association for 41 years and served as its secretary for thirty and one-half years. At Wednesday afternoon's session we will commemorate and honor his memory. Carl S. Heritage, past-president of the association, passed away August 31. He was president during the years between the 1930 and 1934 conventions. A fitting tribute to these and others who have left this earth will be presented later by the Obituary committee.

Past-president Elmer T. Howson, and the staff of the Railway Engineering and Maintenance, have again edited and published our committee reports in an advance issue of that magazine. Copies have been distributed in our meeting room for your use in following the committee reports as they are presented. For this and other assistance rendered our association, Mr. Howson and his staff have our grateful thanks.

Harry Wolf, president, and W. S. Carlisle, secretary, and the other officers and directors of the Bridge and Building Supplymen's Association have done a good job in again bringing us a fine exhibit of the machines, tools and materials which we commonly use. Railroad representatives of the companies exhibiting are here to supply information and advice regarding their use. Make it a point to visit every one of their booths to become acquainted with the products displayed, and with the men who sell them.

Everything that has been accomplished during the year has been the work of many minds, so I thank everyone who has contributed in any way to the work of the association. I cannot express in words my appreciation of the loyalty and faithfulness displayed by the past-presidents of this association. Many thanks are due also to your officers and directors who, in many instances, have given time and effort at a sacrifice of their regular duties and of justified recreation.

I am grateful likewise to the chairmen, vice-chairmen and members of the eight committees whose reports will be presented later. They have done a splendid job at a sacrifice of many hours from their work and from their relaxation time. Nearly all of the 134 men on committees volunteered for the work.

Have you ever wondered why men do these things? They are rewarded by joy in finishing a job once started, by satisfaction in accomplishment, by benefits derived from increased knowledge and experience, and the satisfaction gained from enlarged acquaintance. They know the value of association work in helping men to be alert to fact gathering, active in efforts for improvement, and aggressive in meeting new situations.

Old Timers Loyal

The most gratifying thing that I have experienced as president is the loyalty and devotion to this association that is shown by so many of the 'old timers'. Old members, long retired from active service, write that they cannot get along without a copy of the Proceedings. Widows of members have asked for copies of the bulletins so they can keep in touch with the association. One woman, whose husband spends most of his time in a wheel chair, requested us to send him a membership card, saying it would mean so much to him. The answer to this loyalty and devotion can be found in the "Memorabilia" which was issued last July, in which so many members and friends eulogized our late secretary, Cal Lichty. I ask the present membership to decide whether there is value in such loyalty and devotion, and if they find there is to grasp it and see what it will do for them.

Co-operate With Secretary

I have already referred to the loyal and faithful service given to the association by those actively directing its affairs. I now call your attention to the loyal and helpful service that every member can render this association by co-operating actively with its secretary.

Mr. Whiteman is a railroad man. He was in railway service for 33 years. He is experienced in association work, but he does not know

many of you personally. He will know you personally to the degree that you make yourself known by correspondence with him. He is your storekeeper. You must let him know what you need, otherwise he will be sending you a spike maul when you need a crosscut saw. The growth and effectiveness of our association depends in a large measure upon the help you give your secretary. An association of passive, dues-paying members, of which only five or ten per cent volunteer for committee work, can succeed financially; but the same association, with everyone an active member, and by his activity showing he is ready, willing and able to serve, will possess unlimited possibilities of service to its members.

The presidency of your association changes each year, with resulting changes in the types of men

chosen for office, but the secretary carries through, and by virtue of the information and records assembled in his office becomes the link that connects each year's work with that of the succeeding year. You must make it possible for the secretary to keep in close contact with the membership of the association.

Are You a Booster?

I want you to answer this question: Are we boosters for our association? In studying our problems, do we ask, "what does my association say about this question?" I assure you that railway men outside of our group inquire about the information contained in our reports. There is the chief engineer who frequently says, "Now, the Bridge and Building Association is a good organization, find out what it says about this question." I'll hazard the guess that we as members of this organization probably make less use of the information contained in our Proceedings than do many of the men who are not members.

Do we as members see to it that our association is advertised to the fullest extent? Many trade publications publicize our meetings without solicitation on our part. A short time ago I heard this from a large manufacturing organization: "We are carrying notice of your convention in our October issue, which will reach 85,000 persons." I wonder how much publicity each of you men, as members of this group, gave to this particular meeting? Many trade bulletins and engineering publications recognize the value of the work we are doing and give publicity to our activities. Do we, who should be intimately concerned in these things, do our part in bringing our work to the attention of others who can be of help to us?

In closing, I want you to know how much I appreciate having had the privilege of serving you during the year now closing. I have enjoyed the work immensely.

Special Committees Appointed

President Bechtelheimer: The following Special committees are appointed:

Nominations: Armstrong Chinn, Chairman; C. M. Burpee, E. T. Howson, Maro Johnson, C. R. Knowles.

Subjects: H. M. Church, Chairman, E. C. Vandenburgh, I. A. Moore, R. E. Caudle, K. L. Miner, R. E. Dove, and E. T. Howson.

Auditing: T. H. Strate, Chairman, G. E. Boyd, Martin Meyer, C. A. J. Richards, and F. O. Whiteman.

Resolutions: N. D. Howard, Chairman, G. S. Crites, H. Heizenbuttel, and J. W. Kidd.

Convention City: R. E. Dove, Chairman, H. M. Church, F. H. Soothill, W. A. Hutcheson, W. A. Batey, and W. A. Sweet.

Obituary: L. D. Hadwen, Chairman, L. E. Peyser, G. A. Rodman, E. E. Tanner, and F. O. Whiteman.

President Bechtelheimer: We are now ready for the Committee Report on The Mechanization of Bridge and Building Forces.

M. H. Dick, Chairman, read the report (See page 53).

The session recessed at 12:10 p. m.

Afternoon Session

Tuesday, Oct. 15, 1940

The meeting was called to order at 2 p. m. by the President.

President Bechtelheimer: We will now discuss the report on the Mechanization of Bridge and Building Forces. (See page 53).

After dismissing the committee, President Bechtelheimer called for the report on The Detection and Elimination of Termites in Railway Structures.

T. H. Strate, read the report (See page 167).

President Bechtelheimer: Next, we will be addressed by Otto Kuhler, and I will ask Elmer T. Howson to introduce him.

(For Mr. Howson's introduction, Mr. Kuhler's address and following discussion, See page 109).

President Bechtelheimer: Now we will give you an opportunity to meet your friends, study the supply men's exhibits, and get ready for Mr. Rear's address here tonight.

The session recessed at 4:15 p.m.

Evening Session

Tuesday, Oct. 15, 1940

The meeting convened at 8:20 p. m., President Bechtelheimer presiding. It was a special meeting arranged to give members and guests at the convention an opportunity to hear an address by Geo. W. Rear, bridge engineer of the Southern Pacific, Pacific Lines, on the Bridges on the Shasta Line Diversion of the Southern Pacific. More than 150 were in attendance to hear the address, which was accompanied by lantern slides and motion pictures. (See page 99).

Morning Session

Wednesday, Oct. 16, 1940

The meeting convened at 9:40 a. m., President Bechtelheimer presiding.

President Bechtelheimer: Yesterday afternoon, we held over the report of the Committee on The Inspection of Buildings to Formulate the Maintenance Program. Will Mr. Peyser and his committee please come to the platform and we will start that report.

L. E. Peyser read the report (See page 135).

President Bechtelheimer: We will now have the report of the Committee on Protecting Steel Structures from Severe Corrosion. A. M. Knowles, of the Erie, is

chairman of this committee, and I ask Mr. Knowles and his committee to come to the platform.

Chairman Knowles: Mr. President, I wish to preface the report with a few remarks. A review of recent Proceedings of this association reveals that within the last five years, there have been committee reports on various phases of this subject, especially the one presented last year by Mr. Johnson, which have covered the situation fairly well. Your committee has found that substantially the same conditions and practices prevail on the railroads now as at the time of these previous reports, leaving little new material along this line to present. It was thought, therefore, that some fundamental data on the theory of corrosion and coatings might appropriately be included in this report, stripped of technical symbols used in chemistry, in response to many questions raised on this phase of the subject.

Mr. Knowles read the committee report. (See page 120).

President Bechtelheimer: I will ask Mr. Howson to introduce the next speaker, H. R. Duncan.

(For Mr. Howson's introduction, Mr. Duncan's address and the following discussion, See page 79).

President Bechtelheimer: We will now hear the report of the Committee on The Repair and Renewal of Ballasted-Deck Bridges.

(W. A. Sweet, chairman, read the first part of the report, and was then interrupted when it became time for the Annual luncheon.) The meeting recessed at 12:10 p. m.

Annual Luncheon

Wednesday, Oct. 16, 1940

President Bechtelheimer: I am happy to welcome you here today. Our Wednesday luncheon has come to be an important part of our convention. I do not know when it first became a part of our program, but I do recall that the first one that I attended was at the Louisville convention. It was attended by our own group and a few guests. In later years we have been fortunate in being able to expand the scope of this function, affording through it an opportunity for our executive officers to look in on us and to gain some idea of the work we are doing.

We have a group of vice-presidents and general managers as our guests today. I shall ask Mr. Howson to introduce them.

Elmer T. Howson: Mr. President, I am sure that we are all very happy to have with us as guests those who are here today at the speakers' table. During the year we have had some changes in the officers of this association. I am going to take the liberty of presenting them, too, because some of our members and others who have joined with us at this luncheon have not met them.

. . . Mr. Howson thereupon introduced the following guests and officers of the association:

F. E. Weise, chief clerk, Engineering department, C. M. St. P. & P.

W. A. Kraemer, assistant general manager, C. & N. W.

Arthur Montzheimer, retired chief engineer, E. J. & E.

Samuel O. Dunn, Chairman of the Board, Simmons-Boardman Publishing Corporation, and editor, Railway Age.

George W. Rear, engineer of bridges, Southern Pacific.

H. B. Voorhees, vice-president, B. & O. C. T. and Alton.

R. E. Dove, assistant engineer, C. M. St. P. & P.

G. Metzman, assistant vice-president, N. Y. C. Lines.

H. M. Church, general supervisor bridges and buildings, C. & O.

J. D. Farrington, chief operating officer, C. R. I. & P.

F. H. Soothill, chief estimator, I. C.

J. H. Aydelott, general manager, C. B. & Q.

J. P. Wood, retired supervisor bridges and buildings and water service, P. M.

F. R. Gerard, general superintendent, P. R. R.

R. H. Ford, past-president, American Railway Engineering Association.

W. L. Fox, general superintendent, Belt Railway of Chicago.

F. O. Whiteman, newly-elected secretary, American Railway Bridge & Building Association.

President Bechtelheimer: Thank you Mr. Howson.

Our speaker today is Bruce E. Dwinell, of the Rock Island. Mr. Dwinell has done brilliant legal work not only on his own railroad, but has gone outside of his road as a representative on national committees dealing with labor matters. I take great pleasure in introducing, at this time, Bruce E. Dwinell.

Current Railway Problems

By Bruce E. Dwinell
General Attorney, Chicago, Rock Island & Pacific

B. E. Dwinell

Mr. President, I think I should say at the very beginning that for much of the background of my statements today, I should pay acknowledgment to one of God's good gentlemen and a great engineer, with whom I spent some weeks this last winter absorbing information, knowledge and inspiration. I refer to Mr. Robert Faries of the Pennsylvania, whose recent death is, indeed, a great loss not only to the railroads, but, in particular, to the engineering profession of the railroad industry. He was a great man.

Benjamin Franklin was born in 1706. He died in 1790 at the age of 84. In 1789, immediately after George Washington was inaugurated president of the United States, Mr. Franklin wrote a letter to a friend in France in which he made this statement: "Our Constitution is in actual operation. Everything appears to promise that it will last, but in this world nothing is certain but death and taxes."

I am not going to speak of our Constitution; I am not going to speak of its promise for the future; I wish to confine myself wholly to the last statement that Mr. Franklin made: "but in this world, nothing is certain but death and taxes."

Since his time, it is true that, while medical science has perfected processes which may prolong life, death is still certain. Taxes, it seems, were certain in those days, but today we find that the tax gatherer has perfected new and better methods of collecting taxes, so that while death may not come quite so early, taxes are still more certain.

Since Franklin's time there have been many changes. If we go back into history, however, we realize that in the two thousand years that preceded Franklin's life, there had been no important scientific discoveries or inventions. Life in Franklin's time was substantially the same as it was in the time of Christ. There had been some refinements of knowledge, but no great advances in knowledge, and, as a matter of fact, some of that which had been known by the Greeks and the Romans had been forgotten and had to be rediscovered, if, indeed, it has been all rediscovered.

There were only three things which had been invented or discovered in the two thousand years before and during Franklin's time which changed the course of events of the world. One was the printing press, about 1450; but even in Franklin's time, the flood of newspapers, magazines and books had

not come upon us. Gun powder had been invented in about the year 1300, or at least was introduced into Europe about that time, but its use had not been perfected in the operation of engines of destruction as we know them today. The steam engine was perfected by Mr. Watt about 1750, or during the lifetime of Mr. Franklin. These were the three inventions of two thousands of years which changed materially the progress of the world.

Much Has Happened Since 1790

But let us see what has happened since that time. In 1790, the year of Mr. Franklin's death, the United States Patent office was founded, and in that year only three patents were issued. In 1800, ten years later, when certainly the knowledge of the existence of the Patent office had become widespread, only 38 patents were issued, while today, we are issuing patents at Washington at the rate of about 50,000 a year.

It was only four years after Mr. Franklin's death that the cotton gin was invented by Eli Whitney, resulting in the great increase in the acreage and production of cotton. This was followed within a short time by the adaptation of the steam engine, which had been invented only in 1750, to the steamboat and the railroad. Next came the telegraph. The harvesting machinery was invented just before the Civil war. Then came the telephone, then the automobile with the gas engine; finally, the airplane; and last, the radio.

So fast has been the development of these mechanical processes, inventions and discoveries that the radio as we know it today may be in just a very short time a thing of the past, to be replaced by television. We are faced today in the radio industry by perhaps the scrapping of the modern sending stations in favor of a new type of station. The further we have gone, the faster has been the progress and the change.

I remember the first automobile that I saw. My father saw his first automobile on the same day. I remember the first telephone that I saw. My father saw one not very long before. I remember my first electric light. My father saw one at the World's Fair of '93. He died before the radio came in.

Changes in Everything

It is not only in the field of mechanical development that there has been change. We have had it in all phases of our life.

I graduated from college in June, 1914. I had been brought up to believe the homely principle that all would be well if one were honest, worked hard and saved his money. In 1914, the United States was economically prosperous. It could look back upon a period of a hundred and more years of steady, continued growth, broken only by a few panics, out of each of which the country emerged stronger and wealthier than it was when it entered into the panic. Peace was being promoted and talked about. It was believed that finally man had become so intelligent that he would never again resort to war in order to change things to his liking. It was believed that we had seen our last war, but in July of that same year—one month after I graduated from college—the Arch-Duke and his wife were killed, and within 30 days more, there broke out upon the continent of Europe a great con-

flict, which, within a period of three years, was to engulf the world.

There came a peace which everyone thought was a lasting peace and would result in there being no more war, but since that time there has been no peace, no security. All has been uncertainty and insecurity, until finally within the last year we have seen almost the entire world, except for the United States, plunged into a great conflict.

Today, as we look at the future, it is uncertain as to politics, economics, mechanics, science and engineering. Of one thing only are we sure, and that is, that uncertainty as to the future is sure. If Benjamin Franklin were here today he might well amend his statement to read: "Our Constitution has been in actual operation for over 150 years; everything appears to promise that it will last, but in this world of today, nothing is certain but death, taxes, and uncertainty."

Others Than Railroads Have Their Problems

These changes that have taken place in economics, in the habits of thinking of the people, in mechanical and engineering matters, have produced problems. They have produced problems for the railroads, but I do not think we should forget that at the same time they have produced problems for us, they have produced problems for others. We are not alone in our uncertainty as to the future.

Let me illustrate. A few days ago I picked up on the train a Dun & Bradstreet report on the future of stores in small towns. It was not only a statement of facts and figures as to the number of stores in towns now and ten years ago, and so on, but it was also an attempt to forecast the future of the stores in small towns.

I was impressed particularly by one table. It contained a summary of information given by storekeepers in small towns as to the reasons for their failure to get along better. They gave as some of the reasons, chain stores, price changes, style changes, crop failures, plants shut down, unemployment, etc. But there was one item of cause of their trouble which was predominant, accounting for 57 per cent of the failures of stores in small towns, and that was the motor vehicle on the highway; people leaving the small town to do their trading in the larger trading centers. That is what the motor car, the truck, and the highway has done to them.

One of the things that has caused the trouble of the farmer has been the very motor car and truck that have caused much of our trouble. Formerly, the farmer raised his own motive power, or bought it cheaply; now he must buy a truck. Formerly, he raised his own fuel for his power—his horses and his mules; he raised corn and oats and hay. Now he must buy gasoline. At the same time that he has increased his operating expenses, he has lost the market to justify the tilling of millions of acres of land which formerly produced corn, oats, straw and hay for the horses in the city. He has been hit both ways.

We have been hit by the same instrument which has caused the troubles of the farmer; the troubles of the storekeeper in the small town. As the advance has made trouble for them, it has made trou-

ble for us. Just as higher taxes have hit us, they have hit others; just as higher operating costs have hit us, they have hit others. We are all in the same boat so far as that is concerned.

While it is true that the changes which have produced uncertainty have resulted in great benefit to the human race, they have also produced troubles for those who are already in business or who are attempting to enter business.

Is There an Answer?

I come, then, to the question: Is there an answer to the problem of uncertainty caused by scientific advances and the changes in economic thought? and wish to discuss briefly two of our problems.

We are beset on every side by increased operating costs, increased taxes and increased commodity prices. In your hands, and the hands of men who are occupying positions like yours, lies the answer to those problems of increased costs, no matter what they may be.

I don't say that you can do anything about the increased tax cost, which is one of the major problems. I don't say that there is anything that you can do directly about the diversion of traffic to the motor truck on the highway. The salvation, however, of the American railroads lies in just one thing: increased efficiency at a decreased cost. If the American railroads can not solve that problem, it can not be said that our future as private enterprises is bright.

Before I discuss the problem as it directly affects the railroads, I want to call your attention to the fact that our competitors are hit with the same problems with which we are confronted. They, likewise, are confronted with the problem of higher taxes. Eventually, their tax bill will equal ours. They are confronted with the problem of increased wage costs, which has been one of the unfair things which we have been compelled to face and to work under during the last few years. We may be expecting that the motor carriers, for instance, in the near future will have a wage bill equal to our wage bill. Just as scientific advance has injured us, we may expect that scientific advance in the future may injure them also, so that a part of our burden will be taken away from us by the equalization of our competition.

How Decrease Costs?

But there still remains the question for us to face, and that is, how we are to decrease our costs and cope with our problems?

We must, if we are to survive, deal more and more intelligently with the labor problem. One of the difficulties which you men have in your handling of labor problems, I know, is the fact that the territories over which you have jurisdiction are vast in extent. Our railroads are large, they cover large territories and they have employed upon them men who are scattered over the entire system. This makes the problem of supervision extremely difficult.

You men who are in charge can not give to the individual labor problem as it arises the individual attention which it well deserves. You must delegate your authority, and in the proper and wise delegation of that authority lies much of our hope for the future. The man who has contact with labor is the man who actually works with labor; your foreman, your

man on the ground. Your employees know your railroad by knowing your foreman. If he is a good foreman, your railroad is a good railroad; and if he is a bad foreman, your railroad is a bad railroad so far as that man is concerned.

It is necessary then, that this foreman be a certain kind of man. A really excellent foreman has to have two qualities. One is technical knowledge of his subject, and the other is the ability to handle men. Of the two, the first is of the lesser importance initially. Given a certain aptitude, a certain ability and a willingness to work, men can become technically proficient, but the ability to handle men is something that is born in a man. He either has it or he hasn't it. It can not be cultivated. It requires honesty of purpose; it requires a knowledge of human nature; it requires an intense desire to be fair and square. But a man can have all of these and still not be a perfect boss. It takes something of a spark to make him right.

So I say that the first thing for you men to do in your handling of the labor matter is to see that your foreman is right and can handle his men. If he can do that, much of the cause of complaint which often ripens into real crises in labor matters, can be avoided.

Must Continue Technical Advances

Now I turn to the other phase of your work, and that is the technical phase. Much that I know of this, as I said at the beginning, I learned from Mr. Faries. Great advances have been made in the maintenance of bridges, structures and track since 1916 when the costs of operation and maintenance began to rise abnormally. It has only been by intensive mechanization that the railroads have been able to keep up with those rising costs.

It is unnecessary for me to go into all of the details of the new machines which have been adopted, of all of the methods which have been perfected. All that I want to say as to that is this—that only upon the utilization of every sort of knowledge, of every sort of device, of every sort of improvement in the operations done by you men and others occupying like positions, can our operating costs be reduced and the railroads maintain their place in the sun.

Yours is a double task. Your first task is to so do your work with improved machinery that it produces efficient, economical maintenance of your properties; and your second task is to handle your employees so that you will secure from them the best that they can give. If you can fulfill this double task, and if others in the railroad industry will intelligently follow the same course, there is hope for the railroads in the future so that it need not be said that all is dark and that none can tell what will occur. In spite of the uncertainty produced by these economic, social and engineering changes there will come the certainty which we must have for the future. (Applause.)

President Bechtelheimer: Mr. Dwinell, we thank you for the inspiring talk that you have given us. You have given us many things to take back home; things that we should think about.

Afternoon Session

Wednesday, Oct. 16, 1940

The meeting was called to order at 2:15 P.M., President Bechtelheimer presiding.

President Bechtelheimer: Mr. Sweet has read part of the committee report on The Repair and Renewal of Ballasted Desk Bridges and will continue from where he left off before we adjourned for lunch.

Mr. Sweet concluded the reading of the committee report. (See page 66).

President Bechtelheimer: The next report is that of the committee on The Adjustment of Locomotive Watering Facilities to Larger Tenders and High-Speed Trains. Mr. Powrie, chairman of this committee, could not be here today. Mr. M. A. Bost, of the Milwaukee, who assisted Mr. Powrie in assembling this report, will read it.

Mr. Bost read the report. (See page 157).

President Bechtelheimer: We have programmed an "In Memoriam" session in honor of our late secretary, Calvin A. Lichty. Mr. Howson will take charge of this part of the meeting.

In Memoriam

Calvin A. Lichty

Elmer T. Howson: Mr. President and Fellow Members: This association has been unique in many ways; it has characteristics all its own. I said yesterday to Mr. Whiteman—who, as you know, is secretary also of the Roadmasters' and of the Superintendents' associations—that each association has characteristics that are found only in that organization.

This is the thirtieth consecutive convention of the American Railway Bridge and Building Association that I have attended. In those thirty years I think I have come to know the characteristics of this association. The one characteristic above all others that has impressed me through the years has been the unusually friendly interest that the members have shown in each other, and the extent to which they look forward from year to year to returning to the annual conventions, not alone to increase the store of technical information that they can use, but also to renew friendships. More of the families of the members of this association attend its conventions than is true of either of the other organizations, or is true of any similar railway organization that I know of. It is a friendly family organization, and even among those men who do not

bring their families, that same friendship exists.

The American Railway Bridge and Building Association is unique in another respect. This is its 47th annual convention, and in these 47 years of the association's continuous history, it has been served by only two secretaries. I came into the association just as its first secretary was passing out of the picture. He had just given up his active duties, but he was still interested in the association and continued to attend its conventions. The "old timers"—and I think there are probably 20 of those men here—and some of the ladies, will remember S. F. (Deacon) Patterson, the first secretary of this association.

As Deacon Patterson became less active with advancing years, he had an understudy, a man who gradually fitted into the picture and took over the work that he had discharged during the early years of the association. As a result, when Deacon Patterson officially and formally severed connections with the association, there was almost no jar, because, under the new secretary, the association continued smoothly along the lines that he had established.

1865

1940

Calvin A. Lichty

The secretary who took hold at that time carried on for more than 30 years; he was in his thirty-first year of association service. That is an unusual record. It is an unusual record for any man; it can not help but build a man into an association. The man who took on those duties was an unusual man.

I am not saying that merely to pay tribute; I am saying it because I know it is in the minds of all of you.

I know of no man in this association's work on whom so many of the members have leaned through those years (who leaned unfairly sometimes in the demands they made upon him) as the one who served this association as secretary through those years.

We are gathered here today because that man relinquished those duties a few months ago and this association faces for the first time in the history of most of those here, the problem of adjusting itself to a new secretary. We could not let pass out of the picture the man who has served us through these years without thinking over some of the contacts, some of the services, some of the friendships that were formed during those thirty and one-half years.

To this end, I am going to call upon others who will share recollections of Cal Lichty with you, and especially so that those of you who have come into the association in more recent years may realize some of the principles on which this association was founded, and may be inspired to carry on these principles that were laid so firmly, and, we think, so constructively, by Cal and by those who have been associated with him through the years.

First, I want to call on one of the veterans of this association who had as much fun with Cal as anyone. They had many jokes together; they enjoyed the company of one another, as did their families. This man has contributed much to this association by his energy, his enthusiasm and his ability to argue on either side of any question in our discussions. He was one of Cal's closest friends, and that friendship was built through this association.

I am sure our younger members, as well as our old timers, want to hear from this man about Cal Lichty's connection with this association; what it meant to him as a member, as an officer, and as a past president. The man I have in mind is J. P. Wood.

J. P. Wood: Mr. President, Ladies and Gentlemen: A part of this afternoon has been set aside to do honor to, and to show our affection for, a truly great man—one who was beloved by us all. It is possible that many of us did not realize his strength and greatness, so let us pause for a few moments and ponder on the manner of man he was.

Some men are born great; others have greatness thrust upon them. Some achieve greatness by an abundance of energy, by close application to the tasks at hand, and a never-failing loyalty and fidelity to their superiors, their equals and their subordinates. Others are just naturally great, but do not realize their greatness.

As the result of the many years of our close association, and the many opportunities that we have had to study Cal Lichty, I am firmly convinced that he belonged to the last mentioned class in a greater degree than to any of the others. Yet, when we pause and attempt to analyze his character, it is not hard to believe that he was a composite of all the above classes. There was an impelling force in the makeup of this man that compelled him to forge ahead through childhood, the adolescent period, the teen age, to the matured man.

We are all aware that it is during these periods that our habits are formed, that our characters are crystallized, and that the setting of our future life is developed.

Did Cal Lichty measure up to the above? If so, then indeed he was born great.

Having greatness thrust on one, does not mean necessarily that he must perform some feat or do an outstanding act that brings him before the public with much acclaim. Steady adherence to principles and duty often attracts the attention of people so that men are declared great.

A man may achieve greatness through various channels and by devious ways. He may be a plodder, constantly doing with all his might whatever his hands find to do, and doing it well, until he is acclaimed. He may be of the aggressive type that forges ahead regardless of any obstacles that beset his path. Such men soon attract attention to themselves and thus are spurred on to greater heights until at last they reach the pinnacle.

Cal Lichty was not the type of man who aspired to become great to satisfy his own ego, but was rather satisfied to fill the niche in which he was cast, and fill it well. Ambitious, yes, but not ruthless. He always respected the rights of others. His ambition, I am sure, was a product of his early training and the habits formed early in life. Unlike the type who will ride rough-shod over anyone who happens to be in his path, to attain his own selfish ends, Cal's nature was to lend a helping hand where needed; to give advice when asked, in a friendly manner and a kindly spirit. He was endowed with untiring energy and performed his tasks faithfully and well, with no show of bluster or loud clamor. He often did extra work to help a worthy cause, or went out of his way to be of assistance to someone less fortunate than himself.

His was a kindly nature with a true Christian spirit, which we who knew him best saw exhibited on many occasions. He was always fearful of giving offense, or of doing anything that might cause a heartache or create an enemy. My association and experience with him—the many conversations we had on various topics; his advice, so freely given when requested—during my year as your president, will linger as pleasant memories as long as time for me shall last.

A true, loyal and faithful Christian gentleman and friend, was Cal Lichty.

Mr. Howson: We humans are funny animals. We all have interesting characteristics. As I think back over my association with Cal, particularly in the earlier years of that association, there was one little trick that Cal liked to pull, that I shall always remember. I wonder how many of the old timers remember the thimble that Cal used to carry in his pocket, and how he would put it on the end of his finger, and then, with a quick movement of the hand, it was gone. Cal got a great kick out of that, and we did too. It was those simple things that endeared him to us.

There was another thing that Cal and some of the rest of us got a great kick out of. There is a certain part of the United States in which the weather is always unusual when you are there. This fact gave rise to an exchange of rather voluminous correspondence about the weather, earthquakes,

and other things that happened or did not happen, between another past president of this association and Cal.

One of the keen pleasures that Cal got out of life was the receipt of letters from George Rear, because in those letters there was always a plug for California. Cal would get a chuckle out of that and would bring them around to show others of us. Many of the people who wrote Cal never realized the extent to which he circulated those letters, because Cal had a group of friends to whom those letters would go and we all had a chance to read them.

So, although George Rear may not realize how many of his letters lauding California went around among other members, I remember particularly one other past president who always got an especially great kick out of the letters that Cal received from him. That was Clarence Knowles. Up to the last George was writing those letters and Cal was enjoying them and was kidding George in return. There was an unusually close friendship that grew out of this association. I am sure we would like to hear a few words from George Rear with regard to that long association, officially as between president and secretary, and unofficially, as between friends. George Rear, past president of the association.

G. W. Rear: Mr. President, Ladies and my Brethren of this association: I am handicapped this afternoon, for the first time possibly in my life, in having been asked only a few minutes ago to say a few words at this time. I know I will spend all the rest of my life thinking of the things I should have said but which I can not say today because my thoughts are so wound up in the subject that they would require days to untangle.

There comes a time like this in most everyone's life when the microscope is turned on their character, possibly after he is gone, sometimes before. It must be a wonderful thing to live the kind of life that that microscope can be turned on by friend or foe, and the search find nothing but good.

None of you really knew Cal Lichty, and I did not; but I knew him better than anybody on this earth. Most of the letters I wrote to him were on the torn-off edges of newspapers or something of that sort; some of them were maybe as long as this room. But for many years we carried on a correspondence which enabled me to know him better than any other man knew him, including John Wood.

This association has been a wonderful association, founded by men similar to those who founded the United States of America. Their characters would stand the same scrutiny that we are now casting on another member. The association, at its very beginning, had a secretary who was the man for the place. No institution could ever have come into being and have been this kind of an institution without Deacon Patterson having been its first secretary. Presidents come and presidents go, but they have but little influence on the association as an association. Somebody has to keep the membership tied together. The president has nothing to do with the tying of the association into a unit; the president sees the membership but little, and then too late. Our president this year has not seen many of you

until this meeting, and has been so busy that he has not had an opportunity to more than see you as a group.

As secretary, Deacon Patterson was able to tie the association together, to start it on a road, and to lay down a path which has been followed throughout. I knew the Deacon very well and had a very close association with him. In the many letters that I received from him were things that probably started me on the paths that I have followed.

We were much broken up when the Deacon got too old to carry on, but in an association of this kind, it seems as though at the critical moment there is always somebody who is there and prepared to take up the reins and carry on. This association was very fortunate that at that particular minute 30 years ago, Cal Lichty was ready, young enough and energetic enough to take on and carry on the work without any confusion in the association.

I have often thought of that little rhyme:

"Oh, for the power, or gift to gie us
To see ourselves as others see us."

You, as I have already said, did not know Cal Lichty. You probably knew one side of him, probably two sides; but there were hundreds of sides, and I could spend more time than we all have available telling you of those many sides, each and every one of which was a side that was to be admired and to be loved.

Mr. Lichty was not a strong and vigorous man. He spent years in working hours over the affairs of this association, time that he should have spent in another manner for his own health. He spent evenings and half of the nights on the affairs of this association, doing this night after night. He was a diligent man, who did not neglect any of those duties which were his, regardless of how much it took out of him.

Then he was another type of a man; he was a capable man. Anyone who was acquainted with him would know of his capabilities. Just think of addressing letters to each and every member of this organization, and doing it yourself, to say nothing of putting on the postage to get them into the mails. This is some job for a man who is doing a full day's work besides. After he retired, of course, it was a little easier for him, but we must remember that at that time Cal Lichty was an old man. He was 70 years old when he retired and was not as well, or strong as some of us are likely to be.

Cal Lichty was also a very capable man in that he always did what he was expected to do. He did more than he was expected to do. His principal asset was his desire to be of service to someone else. I could cite a case, which I am sure will not be embarrassing to anyone here.

One time we were at one of our meetings in a distant city and we took a trip to see certain work that was going on. With us was a man and his wife, and a little girl six years old. After we had walked along about a half-mile, the little girl commenced to cry and said that she had left her pocketbook back where we had been half an hour before. The father said: "Oh, shut up and we will buy you another pocketbook."

She said that she had fifteen cents in it, and he said: "Well, we will fix that up."

But Cal Lichty, who had disap-

peared, returned within about half an hour, with the pocketbook.

I tell you that, not to embarrass anyone who might have been present at the time, but to show the spirit of this man to serve. This man gave it to this association, he gave it to his family, he gave it to his church, he gave it to his job, and he gave it to me, to John Wood, and to many other people who call him "friend."

Going back to this matter of correspondence, it started more than 30 years ago and continued up to the end; in fact, I have a letter that I did not receive until after I had received notice of his death. These letters are sacred; they should not be seen by anyone else now, but they contain to a large extent the history of a very warm friendship and of my regard for a very wonderful man.

Mr. Howson: There has been one thing that, among other things, characterized Cal's work for this association. From the standpoint of one who has had some experience in editorial work, I have always been impressed with the way that Cal built up the editorial standards of the Bridge and Building Association. The proceedings of our association are a credit to it. Not all of the members speaking on the floor are always careful in using the correct tense, or in properly framing their sentences, Cal worked over those remarks restating the thought where necessary, and when they came out they were creditable alike to the one who spoke and to the association. Our proceedings have been of a high character.

One of the men who came into this association and has taken a very active part in recent years, who knew Cal in his later years, who worked with him in this association and also in the Roadmasters' Association, having served as president of both of those associations, with Cal as secretary, is Armstrong Chinn. Mr. Chinn is going to give us something of the impression that Cal Lichty made on him as a more recent member of the association.

Armstrong Chinn: Mr. Chairman, Ladies and Gentlemen: I thought I knew a little about Cal Lichty, but after following Mr. Wood and Mr. Rear I feel that I didn't know very much. I am very glad for what little I did learn in the last few years of contact I had with him.

I have put my remarks on paper and you will note that they duplicate in many respects the things that have already been said, which indicates that Cal made the same impression on me that he had made on his older and better friends.

When Cal Lichty passed on our association lost one of the best friends it ever had, and each of our members lost a personal friend. If Cal had any one outstanding characteristic, it was his friendliness and his love for his fellow men. He liked people and, because of this, they, in turn, liked him. His friendly greeting was familiar to all of us, and we will miss his cheery voice in the years to come. We shall never forget it.

Cal's chief activity and concern for the greater part of his working life was this association, which he served so long and faithfully. He was happiest when corresponding with the membership, especially the old timers, and when editing the annual proceedings. He took great pride in getting out the pro-

ceedings, and many a member, who wondered how the remarks he made in the heat of debate on the convention floor would look in print was, pleased to find that in the proceedings they read just the way he wanted them to. Cal felt that in getting out the proceedings in this shape, he was serving his friends whose activities made up the proceedings, and nothing pleased him more than to feel that he was serving someone. In this we have the key to his truly fine Christain character.

I feel that maybe I knew Cal a little better than many others knew him, because I had the rare privilege of working with him twice, once in the Bridge and Building Association and once in the Roadmasters' Association, he having become secretary of the latter in 1935. During those times I came to know him for the truly fine man that he was. I shall miss him greatly in the years to come, but I shall always be glad I had the good fortune to know and work with him as I did, and to receive the inspiration that comes from association with one who is kind and good.

Mr. Howson: My thoughts go back to the convention at Montreal in 1913, and to an incident that occurred there. It was not a part of the technical sessions of the convention. I don't remember what reports were discussed at that convention. I don't remember any action taken on the floor, but I do remember that after the convention closed, the members had an evening on their hands before their trains left, and somebody said, "Let's have an informal dinner together." Cal went down to the Hotel Queens in Montreal and hurriedly arranged an informal dinner there; with no program, but just an evening of telling stories that came to mind.

I remember also our convention in New Orleans, in 1916, where we had a similar evening on our hands. The convention adjourned on Thursday and we were going on a trip to a sawmill on Friday. Thursday evening Cal said, "Let's have dinner together," and so again he arranged the informal dinner and our members provided their own entertainment.

There is a man here who, I think, was at both of those conventions, and who has been at many other conventions of ours throughout these years. He has been active in the Bridge and Building Supply Men's Association. I remember one year when he was the only supply man to go with the convention to Los Angeles, Cal. There was no formal exhibit there, but exhibit or no exhibit, Tom Lehon knew that he had friends there and he wanted to be with his friends.

Tom Lehon's recollections go back to those days in Montreal in 1913 and in New Orleans in 1916, and to those informal gatherings where the crowd amused themselves by telling jokes on one another and in just having a good time together.

Tom brings to us a picture of Cal from the standpoint of his contact with the supply men, a contact that has been very close through the years, not only as between Tom and Cal, but as between the members of the American Railway Bridge and Building Association and the members of the Bridge and Building Supply Men's Association. We want to hear from Tom Lehon because of

his personal relationship with Cal Lichty, and because of his long interest and participation in the activities of the Bridge and Building Supply Men's Association and our association.

Tom Lehon: Mr. President, Ladies and Gentlemen: As spokesman for the Supply Men's Association, affiliated with your own Bridge and Building Association, we appreciate the privilege of being represented on this program today to be able to join with you in this tribute to the memory of the life of Calvin Lichty.

Over a century ago a kindly Quaker wrote these lines:

> "I shall pass through this world but once. Any good thing that I can do therefore, or any kindness I can show to any human being, let me do it now. Let me not defer nor neglect it, for I shall not pass this way again."

"Cal," as we affectionately called him, must have been familiar with these lines, because his kindly smile, soft voice and natural friendliness meant that he also knew that he would pass this way but once and, therefore, during his useful life he made the most of every opportunity to help his fellowman.

In every human relationship, whether it be business, social or family life, it was natural for him to be thoughtful, helpful and considerate. These qualities of mind and heart were the index of his Christian character, for first and above all else, Cal Lichty was a good man, a sincere Christian, devoted to his church, and always intent on promoting its advancement.

He was an industrious man. He never spared himself. If there was hard work to be done, he buckled in and did it regardless of the state of his health, or how exhausted he might be from some previous exertion undertaken as a part of his duties for the North Western, or for his associates in the Bridge and Building Association.

You young men in this association are familiar with the loyalty and devotion to the railroads of the men who have built up this association. All of these men loved Cal Lichty. He was their friend and they enjoyed their association with him.

At this time when we honor his memory, he would have us include these men who, like himself, labored unselfishly and unremittingly to promote the welfare of their railroads as well as the interests of the Bridge and Building Association.

Every man who lives the full and rich life that Cal Lichty lived, leaves to his friends a legacy of many precious helpful memories, which linger long to inspire and encourage.

Mr. Howson: To most of us Cal was the Bridge and Building Association. He had been its secretary longer than most of us remember. And to most members he was more than its secretary, he was their confident with whom they shared their hopes, their joys and their sorrows. His correspondence with the families of deceased members made large demands on his time: yet his older friends were his joy.

Cal has gone on. He is going to be missed sorely. Our association is the better for his having lived and served it. As we bring this session of remembrance of Cal to a close, it becomes our responsi-

bility to perpetuate the same high ideals that he strove so hard to establish.

Mrs. Calvin A. Lichty: I would like to have all of the members of this association to know that I deeply appreciate your kindess in the beautiful tribute that you have paid my husband.

President Bechtelheimer: Thank you Mrs. Lichty and thank you, Mr. Howson, Mr. Wood, Mr. Rear, Mr. Chinn and Mr. Lehon.

President Bechtelheimer: It will be necessary that we continue now with the report on The Heating of Locomotive Terminal and Shop Buildings. We will now, therefore, listen to the report of the committee on that subject, to be presented by I. A. Moore.

Mr. Moore read the committee report. (See page 147).

The meeting was adjourned at 5:40 p.m.—

Morning Session

Thursday, Oct. 17, 1940

The final session of the convention was called to order at 9:20 a.m., President Bechtelheimer presiding.

President Bechtelheimer: We have this morning, the last report on our program, The Storage and Delivery of Bridge and Building Materials. I have been very much interested in this report all year. Mr. Caudle, chairman of the committee, deserves much credit for the time and effort he has directed to the preparation of the report on this subject. He not only worked closely with the committee members, who are in the B. & B. department, but he contacted many storekeepers to secure their views on this subject. So, what Mr. Caudle has put into his report should be highly authoritative.

Mr. Caudle read the report. (See page 82).

Introduction of Those Attending First Convention

President Bechtelheimer: I should like to do something now that should have been done before, something that we have neglected. We have a special duty to new members and old members who are attending one of our conventions for the first time. They should be given a more courteous reception. Now, to correct that failure I am going to ask all new members, and old members who are attending one of our conventions for the first time, to rise and state their names and railroad connections.

(Nearly one-half of those in attendance arose).

Business Session

President Bechtelheimer: We will now start our Business session. First, we will have the reports of the secretary and treasurer.

Secretary's Report

			Total Oct. 1, 1940
Active members, Oct. 1, 1939		464	
New members added		55	
		519	
Died	8		
Resigned	3		
Retired	9		
Dropped	8	28	491
Associate members, Oct. 1, 1939		22	
New members added		1	23
Life members, Oct. 1, 1939		87	
Retired during the year		9	
		96	
Died		1	95
Honorary members, Oct. 1, 1939		1	1
Total membership, Oct. 1, 1940			610
Total membership, Oct. 1, 1939			574
Net gain during the year			36

Treasurer's Report

Cash balance, October 1, 1939		$ 646.33
Receipts:		
Dues	$1,496.05	
Advertising	410.00	
Literature sales	6.50	
Miscellaneous	33.54	1,946.09
		$2,592.42
Disbursements:		
Salary	$ 541.00	
Stationery and printing	1,107.25	
Office supplies	25.30	
Postage	95.00	
Convention expenses (1939)	46.35	
Convention reporter (1939)	137.80	

Disbursements—Continued

Bad check	3.00	
Exchange and discount	4.70	
Social security tax—employer	9.00	
—employees	9.00	
Miscellaneous	77.98	
Petit cash	10.00	
Engrossing membership certificates	6.36	2,072.74
Cash balance, September 30, 1940		$ 519.68

Reconciliation:

Bank balance, Sept. 30, 1940	$503.68
Undeposited receipts	16.00
	$519.68

Signed—FRED E. WEISE, Treasurer.
Oct. 17, 1940.

President Bechtelheimer: Now, may we have the report of the Auditing committee?

(In the absence of the chairman of this committee, G. E. Boyd presented the report).

Report of Auditing Committee

The Auditing committee has examined and checked the records of the secretary and treasurer for the fiscal year ending September 30, 1940, and has found them correct. The financial statement herewith is in accordance therewith.

Signed:
T. H. Strate, Chairman,
M. Meyer,
Geo. E. Boyd,
F. O. Whiteman.

Subjects Committee

President Bechtelheimer: We will next hear the report of the Subjects committee

H. M. Church: With the interest taken here by our new members, it is very appropriate that we read the list of subjects which your committee has set up for consideration next year. It will give you an opportunity to think them over. We invite you to assist us as much as possible in next year's work. We want particularly to have the active interest of you young men who are coming up in committee work.

Your Committee on Subjects recommends to the Executive committee that the following subjects be assigned for study and report by the committees during the coming year:

(1) Possibilities of off-track equipment in bridge construction and maintenance.
(2) The maintenance and repair of bridge and building work equipment.
(3) Protection of bridges and roadway from river bank erosion.
(4) Welding in water service.
(5) Wearing surfaces for building floors, platforms and roadways.
(6) Modernizing small stations to meet present-day requirements.
(7) Efficient methods of transport-

ing bridge and building and water service gangs.

(8) Recent developments in paint removal.

Signed:

H. M. Church, Chairman,
E. C. Vandenburgh,
I. A. Moore,
K. L. Miner,
R. E. Dove,
E. T. Howson.

President Bechtelheimer: I am sure that these subjects will be developed fully just as soon as the work can be done; everyone will have an opportunity to volunteer for committee work. The committee is dismissed with the thanks of the association.

Resolutions Committee

President Bechtelheimer: Now, we will have the report of the Resolutions committee.

N. D. Howard: The work of this committee and subsequent action on your part enables the association to express appropriately appreciation to the many who have contributed to the success of this convention. It has been a pleasure to prepare our report. Our only regret is that space and practicability do not make it possible to extend our appreciation to everyone who has had a part in the success of this convention.

RESOLUTIONS

That the forty-seventh annual convention has been one of the most successful in the long history of our association, and that the value of its deliberations will extend for beyond the walls of this room in the interest of greater efficiency and economy in carrying out bridge and building and water service work, is beyond question. That this can be said, did not come about by chance. On the contrary, it has been the result of arduous work and closely co-ordinated effort on the part of the officers of the association, many of its members, and other individuals and organizations, far too numerous to make it practicable to make separate individual acknowledgment to all of them here. It is, however, proper and fitting that this association at this time express its sincere appreciation to at least those who have contributed most largely in one way or another to the success of our convention.

Be it resolved, therefore, that in convention assembled, we express our appreciation to the following individuals, committees, organizations and companies for their labors and cooperation before and during the progress of our meeting—

To those railway executives who have shown a deep interest in the work of our association and who have encouraged and made it possible for so many of our members to be present at this meeting;

To the Reverend Walter Henry Nugent, Pastor of the Austin Presbyterian Church, Chicago, for the invocation offered at the opening of our first session on Tuesday:

To C. E. Johnston, chairman, Western Association of Railway Executives, Chicago, for his interesting and constructive opening address;

To Geo. S. Fanning, president, American Railway Engineering Association, and to J. J. Clutz, president, Roadmasters' and Maintenance of Way Association, for the greetings and best wishes which they brought from their organizations;

To Otto Kuhler, consulting designer; Geo. W. Rear, bridge engineer, Pacific Lines, Southern Pacific; and H. R. Duncan, superintendent timber preservation, Chicago, Burlington & Quincy, for the interesting and constructive addresses which they made during the course of our meeting;

To Bruce E. Dwinell, general attorney, Chicago, Rock Island & Pacific, for his instructive and thought-provoking address at our luncheon on Wednesday;

To the Pullman Company for its courtesy in extending half-rate privileges to members and their families in traveling to and from Chicago;

To the Bridge and Building Supply Men's Association and to its members individually for the courtesies and help they have contributed to the success of our meeting;

To the officers and directors of our association, and to the chairmen of its committees for the time and effort they have expended on the affairs and work of the association during the last year:

To Railway Engineering and Maintenance, and to its publisher, the Simmons-Boardman Publishing Corporation, for preprinting our reports and for making available copies for use on the convention floor; and

To the management of the Chicago, Burlington & Quincy for making it possible for our members to visit its system storehouse at Aurora, Ill., and for furnishing transportation for our members to and from same.

Signed:

Neal D. Howard, Chairman,
G. S. Crites,
H. Heizenbuttel,
J. W. Kidd.

N. D. Howard: Mr. President, it is the recommendation of the committee that these resolutions be adopted and printed in the Proceedings.

President Bechtelheimer: Thank you Mr. Howard and members of your committee. Your recommendation will be carried out.

Report of Convention City Committee

President Bechtelheimer: We will next hear the report of our Convention City committee.

R. E. Dove: Your committee appointed to consider the meeting place for the 1941 convention, reports as follows:

A few years ago, due to the poor financial condition of the railroads, no annual meeting of the association was held from 1931 to 1933, inclusive, and permission was granted by the Railway Executives to hold a convention in 1934 with the understanding that the activities of the association would be watched critically. In view of this background, the committee feels that railway business has not increased to a degree that would warrant the selection of a convention city other than Chicago at this time, without the possibility of incurring some thought among railway executives that some of our members would seek to attend the convention for other than strictly business purposes.

It is, therefore, the recommendation of this committee that the 1941 convention be held at Chicago.

Signed:

R. E. Dove, Chairman,
H. M. Church,
F. H. Soothill,

W. A. Sweet,
W. A. Batey,
W. A. Hutcheson.

President Bechtelheimer: Are there nominations of any other cities for the 1941 convention?

G. E. Boyd: I move that nominations be closed and that the recommendation of the committee be adopted.

H. M. Church: I second the motion.

(The motion was carried unanimously.)

Obituary Committee

President Bechtelheimer: Next is the report of the Obituary committee. Since Mr. Hadwen, its chairman, is not here, I will ask E. E. Tanner to present the report.

REPORT

Chicago, October 17, 1940

To the Members of American Railway Bridge and Building Association:

Whereas, since the date of our last convention, death has removed from our roster the following members:

A. H. Beard—April 27, 1940
J. L. Enright, October 31, 1939
C. C. Gnadt, December 23, 1939
C. S. Heritage, August 31, 1940
C. A. Lichty, April 18, 1940
Geo. Long, March 25, 1940
P. C. Newbegin, January 22, 1940
P. J. O'Neil, September 15, 1940
A. B. Scowden, March 31, 1940

Therefore, Be it Resolved: That the members of this association in convention assembled, express their deep regret and sorrow for these losses, and that as an expression of condolence to their surviving relatives, who also mourn them, this resolution be spread upon and be made a part of the minutes of this meeting, and a copy be sent to the families of these deceased members.

Signed:
L. D. Hadwen, Chairman,
L. E. Peyser,
G. A. Rodman,
E. E. Tanner.

Amendments to the Constitution and By-Laws

President Bechtelheimer: Is there any new business?

F. O. Whiteman: Under new business we have amendments to the constitution and by-laws, made necessary by the separation of the offices of secretary and treasurer, which must be voted upon at this meeting. These were submitted to the membership by mail in compliance with the by-laws.

(Secretary Whiteman read the proposed amendments.)

PROPOSED CHANGES IN THE CONSTITUTION

Article IV, Section 1 (As amended):

The officers of this association shall be a president, four vice-presidents, a secretary, a treasurer and six directors who, with the most recent past president, shall constitute the Executive committee.

Article VI, Section 2 (As amended):

The president, four vice-presidents, secretary and treasurer shall hold office for one year and the directors for two years, three directors being elected each year. All officers retain their offices until their successors are elected and installed.

Article VI, Section 3 (As amended):

The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the Execu-

tive committee. Their compensation shall be fixed by a majority vote of the Executive committee.

The secretary shall also serve as secretary of the Executive committee.

Article VI, Section 4 (As amended):

The secretary and the treasurer shall be required to give bond in an amount to be fixed by the Executive committee.

Article VII, Section 1 (As amended):

Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the Executive committee.

No member in arrears for annual dues shall be entitled to vote at any election, and any member more than one year in arrears may be stricken from the list of members at the discretion of the Executive committee.

PROPOSED CHANGES IN BY-LAWS

Section 6 (As amended):

The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the Executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall, with the secretary, sign all contracts or other written obligations of the association which have been approved by the Executive committee. He shall render a detailed report at least three times during the year to the members of the Executive committee, showing the financial condition of the association and its activities.

At the annual meeting, the president shall present a report containing a statement of the general conditions of the association.

Section 8 (As amended):

It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the Executive committee. He shall also perform such other duties as the association may require.

Section 9 (New)

The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the Executive committee. He shall report at each annual meeting on the condition of the finances.

Section 10 shall comprise old Section 9—no other change.

Section 11 (Amended Old Section 10)

Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

Section 12 (Old No. 11). No change.

Section 13 (Old No. 12). No change.

Section 14 (Old No. 13). No change.

Section 15 (As amended—Old No. 14)

Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Selection of place for next annual meeting.
Election of officers.
Installation of officers.
Adjournment.

Section 16 (Old No. 15)—No change.

President Bechtelheimer: I will entertain a motion for action on the amendments to the constitution and by-laws.

Armstrong Chinn: I move that

the amendments to the constitution and by-laws, as read by the secretary, be adopted.

H. M. Church: I second the motion.

(The motion was carried unanimously.)

Election of Officers

President Bechtelheimer: We will now pass to the committee on nominations, but first, I have a communication that I should like to read:

Chicago, Ill., October 13, 1940.
Mr. A. E. Bechtelheimer, President
American Railway Bridge and
Building Association,
Hotel Stevens,
Chicago, Ill.

Dear Mr. Bechtelheimer:

I have again given considerable thought to the nomination of presidency of the American Railway Bridge and Building Association, and, as last year, I again take the occasion to express the deep regret which I feel in having to submit to the necessity of tendering my resignation as vice-president of the association. This is because of increased duties, involving my personal inspection at this time of the year of bridge structures over the entire Burlington system, including the Colorado & Southern, Ft. Worth & Denver City, Burlington & Rock Island Railway, and other matters, all requiring my personal attention. Also, my health is not of the best.

Respectfully submitted,
Signed: F. H. Cramer.

President Bechtelheimer: I will now call for the report of the Nominating committee, of which Mr. Chinn is chairman.

Armstrong Chinn: Mr. Chairman and members: This is another time when I am pleased to present the report of my committee. Ordinarily, I am never entirely satisfied when I have a report to make, but this time I am, and think you will be too. The Nominating committee has given its assignment careful and serious consideration and has selected what it believes to be an exceptionally able group of nominees. The committee has been in touch with each of these nominees, personally, or by letter or otherwise, and has been assured by each that he will do his best to carry out the duties of the office to which he may be elected. In other words, we were out after a group of workers and not figureheads. The Nominating committee is, therefore, pleased to present the following slate:

For President: H. M. Church, general supervisor bridges and buildings, C. & O., Richmond, Virginia.

For 1st Vice-President: R. E. Dove, assistant engineer, C. M. St. P. & P., Chicago.

For 2nd Vice-President: F. H. Soothill, chief estimator, I. C., Chicago.

For 3rd Vice-President: G. S. Crites, division engineer, B. & O., Punxsutawney, Pa.

For 4th Vice-President: A. M. Knowles, assistant engineer structures, Erie, Cleveland, Ohio.

For three Directors to succeed the Directors whose terms expire this year:

R. E. Caudle, assistant engineer structures, M. P., Houston, Tex.

I. A. Moore, supervisor of bridges and buildings, C. & E. I., Danville, Ill.

W. A. Sweet, general foreman of bridges and buildings, A. T. & S. F., Newton, Kan.

For Director, to fill the unexpired term of A. M. Knowles, advanced to 4th Vice-President: Neal D. Howard, managing editor, Railway Engineering and Maintenance, Chicago.

For Treasurer: F. E. Weise, chief clerk, Engineering department, C. M. St. P. & P., Chicago.

For Secretary: F. O. Whiteman, Chicago.

Signed:

A. Chinn, Chairman,
C. M. Burpee,
E. T. Howson,
Maro Johnson,
C. R. Knowles.

G. W. Rear: Mr. President, I move that the nominations be closed and that I be given the privilege of casting a unanimous ballot for the election of the candidates named.

G. E. Boyd: I second the motion. (The motion carried unanimously.)

President Bechtelheimer: I will ask Mr. Rear to come to the platform.

G. W. Rear: Mr. President, I hereby cast the ballot.

Installation of Officers

President Bechtelheimer: Mr. Rear will induct those elected into office. Unfortunately, our time is short, so I will ask him to make the ceremony as brief as possible.

G. W. Rear: I hold in my hand the first report issued by this association, which at that time was known as the Association of Railway Superintendents of Bridges and Buildings. The meeting was held September 25, 1891.

Prior to that date, a group of men burdened with the duty of maintaining the bridges and buildings on the railroads—and there were more railroads and buildings then than there are now, and badly scattered throughout the country—conceived the idea that benefits could be gained by the formation of an association which would permit each one to help the other; and thereby make their work more proficient and of more value to their employers. Very shortly after this meeting, I had the privilege of looking over their proceedings and annual reports. The man for whom I was working at the time passed them over to me and said, "See if you can find anything in them." I was young and just starting, but the more I tried to find in the reports for my superior, the more I found for myself. I was overwhelmed with the grasp that these men had of the situation.

As I grew older, it was my firm determination to know some of the men who started this association, now 50 years ago. It was not my privilege for some years to meet any of these men, but ultimately I did get acquainted with almost every one of the organizers of this association. I found them to be men, who, of course, anyone would pick out for responsible officers. I began to feel that those who had chosen these men as officers on their railroads were men of vision, who could see the value in a man. In one of our early meetings, an older man said to me, "Look them over. They all look the part."

In the 30 years that I have been active in the affairs of this association, I have looked them over. I do not at any time remember

having seen anyone attending the conventions of this association and taking an active part, who did not look the part. Somebody said to me yesterday at the luncheon, that the men sitting at the head table—the general managers and others—looked the part; looked as if they had been created from the beginning with their particular job in view. In the railroad business, it is seldom that men get into positions that they are unfitted to fill.

This association from its very beginning has had fine officers. Sometimes those in control, looking ahead, do not see the man who is going to take up the reins and carry this association forward in the manner in that it has been carried forward in the past, but nature somehow usually produces the man required.

If I were younger and was to undertake the chairmanship of a subject committee of this association, I would choose the subject I knew least about. Many years ago I began to choose subjects that I knew nothing about, and I found that by the time my report was completed I knew as much on the subject as anybody else. There is real value to those members who work on subject committees.

I have installed a number of presidents into office in this association. I happen to be the "midway" president; the association is 50 years old this year and I was its twenty-fifth president. In those 25 years I have never seen a president come into office who did not meet with my fullest expectations that he would carry on the work in the proper manner.

The tracks have been laid behind us. The general direction in which we are going is in view. The exact direction is not known, but the incoming officers can at least see the "back-sight", and they can take a look at it frequently to determine whether they are still on the proper course.

I take special pleasure in inducting the newly-elected president into office. I believe Mr. Church will be a president whom, if I should be here next year, I will be able to say, "followed the line set up for him and improved the course." It is, therefore with the greatest of pleasure that I hand this gavel over to Mr. Church and induct him into office as your new president.

President-Elect Church: Thank you Mr. Rear for this most inspiring introduction. In accepting this position, I keenly appreciate the honor that you have bestowed upon me. I am also aware of the obligations that this office imposes. I shall take as a guide the most excellent performance that we have had in the handling of the work of the association this past year by Mr. Bechtelheimer. I believe that his efforts are largely responsible for the large number of new members whom we have just welcomed. And that they are actively entering into the work of the association shows the constructive influence that Mr. Bechtelheimer has exerted as president during the the last year.

I feel deeply the responsibility of my office and will make every effort to carry on the work in the manner that Mr. Rear has expressed the wish that it be done.

G. W. Rear: Are the gentlemen who have been elected to the offices of vice-presidents willing to acept those positions? (Assent) Then, without formal ceremony, I will declare you inducted into

office. And are the new directors willing? (Assent) Then I also induct you into office.

I feel a particular satisfaction in being able to induct the secretary into office. It was with considerable feeling that I inducted Cal Lichty into office many times. I feel great regret that I cannot induct him into office again at this time, but in his absence, it is a great source of satisfaction to me to induct Mr. F. O. Whiteman into office as the secretary of this association.

And Mr. Weise, I induct you into the office of treasurer. The only stress I lay down on you is that you make a better report each succeeding year.

Members of the association, all of your officers have been duly installed, and I am sure that they are prepared to "go" just as quickly as we give them the word —and the only direction in which they and we can go is forward.

President-Elect Church: The convention is adjourned.

The convention adjourned sine die at 11:45 a. m.

F. O. WHITEMAN, Secretary.

Thursday Afternoon

October 17, 1940

On Thursday afternoon, through the courtesy of the Chicago, Burlington & Quincy, members left the Union station at 12:30 p.m., by special train, and studied the manner in which bridge and building materials are assembled, stored and distributed in the system storehouse of the Burlington at Aurora, Ill., returning to Chicago at 4:25 p. m.

Many Members Visited the System Stores of the C. B. & Q. at Aurora, Ill.

COMMITTEE REPORTS, TECHNICAL PAPERS AND DISCUSSIONS

The Mechanization of Bridge and Building Forces

Report of Committee

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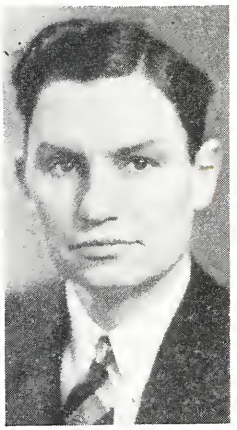


M. H. Dick
Chairman

Mechanization is a broad term used to describe the use of power-operated tools and equipment to perform classes of work that formerly were done manually. In bridge and building work, such operations as the mixing of concrete and the driving of rivets were mechanized many years ago, and it is quite possible that the use of power tools in bridge work antedated their introduction in the track department. During the last decade, however, the trend toward mechanization of bridge and building forces has been given a decided impetus by the development of small portable power tools, such as saws, drills, and wrenches, either pneumatic, electric or mechanical in operation, which are operated from power plants that can be moved about readily.

Types of Equipment

For the purposes of this report it may be desirable to review briefly the types of power tools and equipment that are now available for application to bridge and building work. Among the portable power tools of more recent introduction are timber saws of both the two-man chain type and the one-man safety type; wood augers and drilling tools for various purposes; nut runners and lag screw drivers; and impact wrenches. For the operation of these tools one may take his choice in most cases of either pneumatic, electrical, or flexible-shaft drives, the power in the latter case being furnished by a gasoline engine. In fact, the increasing popularity of power tools for use in the field is due in no small part to the development

of small portable power plants of various types.

In addition to the tools named above, other power equipment that is in common use by bridge and building forces includes concrete mixers, jack hammers, concrete breakers, concrete vibrators, riveting hammers and holders-on, chipping hammers and scalers, rotary wire brushes, welding and cutting outfits, portable grinders, power pumps, sand blast outfits, paint spray guns, motor trucks, track motor cars, pile drivers, and cranes, hoists and derricks. Some of these tools have been in common use on the railroads for many years, while others are of more recent introduction.

Thus, it is apparent that there are power tools and equipment available for performing practically all the more common classes of work that are encountered by bridge and building forces. In recent years the use of power equipment has been greatly extended, not only because of the introduction of new types but because the rising trend of wages and the need for stretching the maintenance dollar as far as possible have made even more imperative the necessity for reducing the unit costs of performing all types of railway bridge and building work.

Obviously, the primary objective in the use of power equipment is to reduce costs, but mechanization also has other important advantages over hand methods. For instance it is generally agreed that the quality of the work performed by mechanical means is better and more uniform than that done by hand. Moreover, with the aid of mechanized equipment, renewal or repair projects can be completed in a fraction of the time that would otherwise be required, thereby reducing the duration of slow orders and resulting in less interference with traffic. Furthermore, there is reason to believe that the use of power equipment results in a reduction in the number of personal injuries.

The trend toward the more extensive use of power equipment has naturally brought to the fore many questions relating to the efficient and economical use of such equipment. Tests conducted with various power tools have repeatedly demonstrated their economy as compared with hand methods. However, in order to realize the maximum return on the investment in power tools it is necessary that, in their acquisition and use, consideration be given to the broad question as to how they are to be incorporated into the bridge and building department as a whole.

In any study of this subject we are immediately confronted with such questions as the following: (1) To what extent are we justified in equipping individual gangs with mechanized equipment (2) In what degree should machines be held at central locations and assigned to individual gangs as needed? (3) What changes in the organization of individual gangs and of bridge and building departments as a whole should be made to assure that advantage will be taken of the maximum possibilities offered by mechanized equipment?

Obviously the answers to these and other questions attending the use of power tools will depend largely on conditions on the individual roads. It was for the purpose of finding out what the maintenance officers of various roads are thinking and doing about the matter that the committee circulated a questionnaire among 53 roads, of which 42

submitted replies, although five of these did not give detailed answers.

Practically all of the roads that submitted detailed answers stated that the trend in recent years had been in the direction of greater mechanization of their bridge and building forces. However, 25 of them still feel that their bridge and building forces are not adequately mechanized, although all of these companies expect that, as conditions warrant, the process of mechanization will be continued until their forces have been adequately equipped. Twelve roads said that their bridge and building forces had all the power tools and equipment that they need at the present time.

Mechanization Not Complete

Enlightening information regarding the direction that mechanization programs are taking was given in answers to a question asking the roads to name the types of equipment that have recently been in the greatest demand. These answers indicated that by far the greatest demand has been for small portable tools, such as saws, drills and augers, and nut runners, with the necessary power plants. However, they also indicated that heavy purchases have been made of a wide range of other items, including paint spray outfits, power pumps, demolition tools, concrete mixers, welding and cutting outfits, sand blast and other cleaning equipment, motor trucks, steam pile hammers, and cranes, hoists and derricks of various types and sizes.

In spite of the fact that the roads have recently acquired large numbers of the types of equipment named in the foregoing, answers to another question indicated that there is still a heavy demand for equipment in the same categories. The answers to this latter question also listed as being in demand today a number of machines that are not now in common use by bridge and building forces. One of these is a small truck crane for handling materials; another is a self-contained gasoline-operated concrete buster; a third is a power-driven pipe-threading machine.

Answers to the questionnaire indicate that there is wide variation in the extent to which the different railroads have mechanized their bridge and building forces and in their practices regarding the assignment of power tools. As to the extent of mechanization, there are on one hand railroads that are only now beginning to equip their forces with the newer types of power tools, while on the other hand there are roads that have completely equipped their forces with the most modern machines. Between the two extremes there is a wide range of practices.

In the method of assignment, at one extreme of practice are those roads that centralize all power tools, assigning them to individual gangs only as needed, while at the other extreme are those companies that have found it advisable to furnish each gang with complete sets of certain power tools, centralizing only the larger and more expensive machines, such as cranes and pile drivers, or those used only infrequently.

What is being done in the way of mechanization can best be illustrated by the use of specific examples showing how the more common types of gangs have been mechanized on representative roads. In this connection it should be noted that, because of fundamental differences in local conditions and in organizations as between different railroads, the committee feels that it would not be possible, or even advisable, to submit

recommendations regarding the mechanization of individual gangs. But it is felt that representative examples showing practices on progressive railroads will serve to indicate the extent to which such roads consider it profitable to mechanize their bridge and building forces.

Types of Gangs

The manner in which the bridge and building forces are organized varies widely on different roads but on the majority of the lines it may be said that there are five different types of bridge and building crews, namely: (1) Division bridge and building gangs, which make routine repairs to buildings, trestles, bridge decks, etc.; (2) steel bridge repair and maintenance crews; (3) masonry repair gangs; (4) paint gangs; and (5) water service repair gangs. Of these, the steel, masonry and paint gangs may be organized on a system, regional or divisional basis, but in either case the problem of mechanization is substantially the same. Water service repair crews are usually division gangs. Some railroads have "composite" or combination gangs which perform the work of several or even all of the types of crews named above.

An example of the manner in which division bridge and building gangs are being mechanized is afforded by the practice of a southern line. On this road, which, incidentally, is among those that feel that their forces are adequately mechanized, the power tools and machines that are furnished as standard equipment to typical division gangs consist generally of the following:

Motor cars and trailers as necessary

Air compressors

Concrete mixers with water heaters

Electric or pneumatic wrenches

Electric or pneumatic wood boring machines

Rotary grinders with wire brushes (pneumatic)

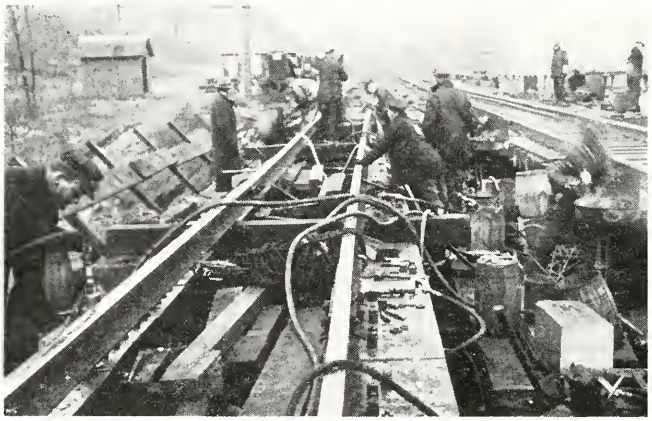
Scaling tools (pneumatic)

Riveting hammers (pneumatic)

Rivet busters (pneumatic)

Small portable paint spray outfits

In addition to these machines, centrifugal water pumps, electric safety saws and motor-car paint spray out-



The Committee Found That the Mechanization of Bridge and Building Forces in Accordance With Sound Practices Offers Numerous Advantages

fits, along with such units as cranes and pile drivers, are held at central locations and assigned to individual gangs as needed. Moreover, at each terminal it is customary for this road to furnish the supervisor of bridges and buildings a 1½-ton auto truck.

By reason of the nature of the work that they perform, steel bridge gangs lend themselves readily to mechanization. Moreover, the majority of the roads have one or more system or regional gangs for carrying out maintenance and repair work on steel bridges and the specialized nature of these gangs is in itself an argument for a high degree of mechanization. Also, the power tools and equipment available for use by such gangs have not only been improved in efficiency and effectiveness, but additional units have been introduced in recent years.

Representative of the highly-mechanized system steel bridge repair gangs of today are those on an eastern line. On this road each steel gang is regularly supplied with the following types of equipment:

Motor cars
Compressors (220 cu. ft.)
Rivet busters
Rivet guns (retainer fitted)
Power wrenches
Circular hand-held power saws
Variable-size chipping guns (retainer fitted)
Oxy-acetylene cutting equipment
Variable speed air-motors for grinders, brushes, drills and reamers
Wood borers and lag screw wrenches operated by reversible motors
Pneumatic bench grinders for dressing tools
Air hoists
Concrete busters
Stone hammer drills
Welding outfits
2½-ton auto trucks
Hand-operated ¼-ton, 1-ton and 2-ton derricks

Equipment that is used infrequently by the steel gangs on this road, such as locomotive bridge cranes and wrecking derricks, is assigned when needed. Occasionally the duties of the steel gangs include the complete painting of major steel structures in connection with repair programs. In such instances a paint crew is incorporated in the gang and paint spray equipment is provided.

Paint Gangs

On the great majority of the roads, paint gangs are organized on a divisional basis, and it is apparent from the answers to the questionnaire that the practice of equipping such gangs with paint spray outfits is almost universal. On a southern line, on which the practice seems to be representative of most companies, division paint gangs are regularly supplied with the following units:

Air compressor
Paint spray outfit (centralized and assigned as needed)
Scaling tool
Scaling hammer
Chipping hammer
Paint scraper
Motor car

In addition to equipment of this type, many roads are now equipping their paint gangs with sand blasting outfits. Other equipment not mentioned above that is in use by one or more roads includes electric chipping hammers, motor-car paint spray outfits, vapor spray cleaning machines and electric sanders.

Owing to the fact that many masonry structures are reaching the age where deterioration is becoming a serious factor, many roads have

found it necessary in recent years to augment their masonry repair activities and numerous lines now have regular masonry repair gangs, most of which are organized on a divisional basis. A representative list of power equipment regularly furnished to such gangs is as follows:

Motor car
Air compressor
Pneumatic hammers of various types
Concrete mixer
Centrifugal water pump

On the particular road that equips its masonry gangs in this manner, a shotcreting machine and a pneumatic sheet-pile driver are centralized and assigned as needed. Equipment not listed that is furnished to masonry gangs on other roads includes concrete vibrators, grouting machines and drilling equipment.

It is apparent from replies to the questionnaire that most railroads have not felt justified in providing a great deal of power equipment exclusively for the use of their water service repair forces, although a variety of such equipment is made available generally when the need for it arises. Equipment of both specific and general-purpose nature that is used by water service forces includes air compressors, drilling rigs, pumps, power pipe threading machines, pipe pushers for underground work, electric generators, metal power shears (in shops) and welding and cutting outfits.

Special Gangs

Most railroads find it advisable from time to time to organize special gangs for performing large-scale tasks, such as deck-renewal jobs on important bridges, that are not encountered ordinarily in routine maintenance work. Because such projects usually involve many repetitions of specific operations, such as the boring of holes for lag screws, they lend themselves particularly to mechanization. In fact it is not uncommon for railroads to purchase power tools especially for use on large jobs with the thought that they will effect sufficient savings on the one project to pay for themselves. Afterwards, of course, such tools become available for use by the regular bridge and building forces.

An example of the manner in which power tools can be used to advantage on large jobs is given by the experience of a western road when renewing the deck of a long viaduct. This viaduct is situated on a double-track line and when renewing the deck it was necessary to operate single-track over it; hence it was desirable that the job be finished as quickly as possible. To this end, power equipment, including bolt tighteners, saws, wood borers and revolving cranes, was used extensively, with the result that the project was completed in one-quarter of the time that would have been required using hand methods. The cost of this project was $28,000, and it was estimated that a saving of $4,000 was effected through the use of power tools.

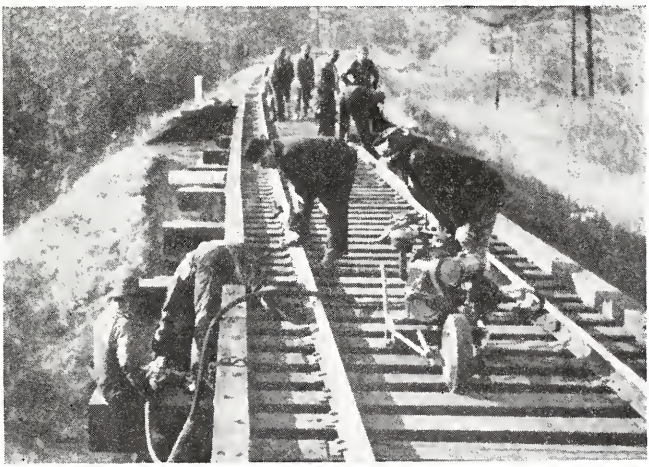
Another road was faced in 1939 with the necessity of restoring six timber bridges that were destroyed during a forest fire. These structures had a total length of 1,266 ft. and a maximum height of 70 ft. The company reports that, with the aid of power tools and equipment, the bridges were rebuilt as frame structures at an estimated saving of $10,000 as compared with the expenditure that would have been required if hand labor without mechanized equipment had been used.

In recent years the electric welding process has gained wide use in the repair and strengthening of steel bridges, and many roads now include among their bridge forces at least a small welding organization, equipped with welding generators, power grinders, and, in most cases, oxy-acetylene welding and cutting equipment. On some roads the welders are attached to the regular steel gangs or they are housed in outfit cars of their own and move about as they are needed. However, at least one railroad has several large independent bridge welding organizations that travel about in outfit cars known as welding trains.

It should be mentioned that electric generators have demonstrated their value as a means of supplying power for the operation of floodlights during emergency night work. The fact that welding generators and those used for the operation of portable tools can be used for lighting purposes adds to their versatility, However, it is not uncommon for railroads to acquire generators specially for the operation of floodlighting outfits.

A development of recent years that should be given consideration in connection with the mechanization of bridge gangs is the trend toward the practice of preframing bridge timbers before treatment. Obviously on roads that have adopted this practice the amount of framing work required in the field is reduced, but on the other hand the concentration of this work at a central point provides excellent opportunities for the use of power equipment under ideal conditions. Equipment that is being used at preframing plants includes cut-off and rip saws, hand saws, planers, and tie borers and dappers. Portable outfits that can be moved about the framing yard and plant have possibilities for use at such locations. In this connection it is worth while to mention that all the advantages incident to the use of power tools in preframing timber for treatment apply also to the framing of timbers that are untreated.

Still another important develop-



Tests Conducted With Power Tools Have Demonstrated Repeatedly Their Economy as Compared With Hand Methods

ment is the increasing use of automobile trucks by bridge and building forces. It has been demonstrated that the use of such trucks for transporting men, materials and equipment results in substantial savings. Here again there is wide variation in the practices on different roads. Some companies do not as yet have any trucks in service with their bridge and building forces, while on others they are being used to a limited extent, such as at terminals or by certain types of gangs. However, a number of roads have become sufficiently convinced of the advantages of highway trucks to furnish them to practically all of their bridge and building gangs.

Programming Necessary

From various sources this committee has obtained records of tests with power tools of various types, which indicate that the savings in labor as compared with hand methods range anywhere from 20 per cent to 75 per cent or more. These tests indicate clearly that the labor-saving potentialities inherent in mechanization are great, but it is obvious that if the maximum possibilities are to be realized the equipment must be used intensively. The use of specialized gangs comprises one way of achieving this result, but it may also be attained where combination gangs are used, by transferring machines from gang to gang as needed. In either case, however, it is desirable that all work be carried out in accordance with definite programs, by means of which those who are responsible for the assignment of work equipment can allot the machines in such a manner that they will be in use a maximum amount of time.

It is to be expected that the widespread introduction of power equipment will be accompanied by at least some changes in the organization of bridge and building forces, but an investigation of this phase of the subject by a committee of the A. R. E. A. failed to reveal any definite trend. Some roads reported that no changes in organization had occurred as a result of the use of power tools, while others stated that reductions had been effected either in the number or size of the gangs. On still other roads a reduction in the number of laborers has been accompanied by an increase in the number of mechanics. This investigation did develop the fact, however, that modern equipment tends to raise the standard of workmanship and requires a better trained organization and closer supervision in programming the work.

Practically all of the railroads answering the questionnaire stated that they had experienced no trouble in getting their men to use power tools; rather the experience has been that the men prefer to work in gangs that are mechanized. In this connection it is reported that the use of power tools has a noticeable effect on the ability of men to perform work. Young and able men who are in the habit of using power tools are inclined to become less adept with hand tools, whereas the less able men who would never become proficient in using hand tools can qualify with power equipment.

Equipment Still Needed

In the questionnaire the railroads were asked to indicate if there is any need in bridge and building work for types of power equipment that are not now available on the market. Several of the answers to this question mentioned the need for a suitable portable power hoist for han-

dling heavy bridge timbers. In this connection, one road advises that it could use a light gasoline-operated derrick that could be easily set up and removed from the track by a few men, while another would prefer to have a portable hoist or crane suitable for off-track use. A third wants a portable winch or crane, fastened to the track or mounted on a motor car, which, in addition to handling caps and stringers, could also be used for laying culvert pipe. In this connection a member of the committee points out that it is desirable to have a small crane mounted on a push car for handling the lighter steel members in bridge erection, such as floor plates and ballast stops. The availability of a machine of this type would make it unnecessary to have work-train service except for the first day of erection.

Another member of the committee feels that there is need for a machine capable of lifting the decks on steel bridges sufficiently to permit the flanges of the stringers and girders to be inspected, cleaned and painted. As he visualizes this machine, it would be self-propelled, presumably with flanged wheels, and would embody power jacks for doing the lifting. This committee member is of the opinion that, because of the extensive use of preframed treated bridge ties and other factors, it is becoming increasingly desirable that bridge decks be disturbed as little as possible, and that the use of such a machine as he has in mind would permit necessary work to be carried out on girders and stringers with a minimum of disturbance to the deck.

Other types of machines that could be used if they were available, according to the answers to the questionnaire, include a device for pulling chord and drift bolts, an electrically-operated under-water cut-off saw; a reversible electric power wrench, not exceeding 40 lb. in weight, capable of driving ¾-in. by 8-in. lag screws; and a power-operated device that would obviate the use of hand tools in finishing daps in timbers.

One railroad that uses electrically operated tools extensively is working with manufacturers to develop a suitable electric nut runner for driving lag screws in guard rails and ties, and believes that it will eventually obtain a satisfactory tool. This company is also attempting to develop a satisfactory electrically-operated tool for driving nails up to the 60d size. In addition, it feels that there is a need for an electric saw for cutting piles and heavy timbers that is lighter and less cumbersome than those now on the market.

It is the conclusion of this committee that the mechanization of bridge and building forces in accordance with sound practices not only increases their efficiency and results in substantial savings, but also tends to enhance the standard of workmanship, to promote safety and to shorten the time required to complete specific projects, thereby reducing interference with train operation.

DISCUSSION

President Bechtelheimer: Mr. Dick, the report of your committee covers the subject in a thorough and able manner. I think it will serve as a yardstick by which roads with highly mechanized

forces can re-check their equipment; and as a standard for those who are beginning to mechanize their forces. The report will stimulate wide interest in the use of power tools.

H. M. Church (C. & O.): I might supplement the comment in the report relative to preframing by stating that on our road, in addition to the preframing of bridge and building timbers, we also preframe telegraph poles, special switch timbers and other railway timber of this general character.

G. S. Crites (B. & O.): I should like to raise a question relative to the operators and proper operation of work equipment. In one part of the report, the committee says that the machines are assigned to one gang. With steel gangs and paint gangs it is evident that qualified and careful operators can be found within the gangs, but when power tools are centralized and are assigned to gangs as needed, it would appear to me that there might be a tendency for the gang last using the machine to just limp through to the end of its work and then push it off onto the next gang. Did the committee cover the matter of the proper operation and maintenance of equipment?

Chairman Dick: That is a very pertinent point. The committee did not mention it specifically in its report, but we gave it consideration. Obviously, when a railroad is giving consideration to the method that is to be used in assigning work equipment to bridge and building gangs it should not overlook insuring proper operation and maintenance.

K. L. Miner (N. Y. C.): I would like to suggest one other machine not mentioned in the report, and that is a paint lineograph machine. It is customary practice on the road with which I am connected to paint a warning line on passenger station platforms to warn of the clearance of trains, and also to paint lines to mark out parking areas at stations. The paint lineograph machine, which is a hand-operated machine that can be pushed along, will paint a line 2½-in. wide. If we want a 5-in. line, such as in parking areas, we accomplish this by two passes of the machine. With the machine, one man can paint 4,000 lin. ft. of line in a forenoon. Without the machine, I don't think we could mark out 4,000 lin. ft. of line with one man in ten days.

President Bechtelheimer: Mr. Miner, do you have such machines in your crews?

Mr. Miner: Yes. We have many station platforms in our territory up the Hudson river where we mark out warning lines for the protection of passengers, so that they don't get too close to the track. I don't know of any machine that has greater labor-saving qualities than this simple paint linograph machine, if you have lines to paint.

President Bechtelheimer: Unquestionably, there is merit in what you say. Does anyone here put lines on in some other way? Is the New York Central the only railroad that paints warning lines?

F. H. Soothill (I. C.): The Illinois Central employs the lineograph on all suburban platforms in the Chicago territory.

J. J. Clutz (Penna.): I should like to go back to Mr. Crites' ques-

tion about the operation and maintenance of machinery; particularly large machinery that is moved about from gang to gang. We find it very important to watch that factor. Each of our larger machines, such as pile-drivers and cranes, has a permanent operator assigned to it, and no matter where such a machine goes its operator goes with it and is, of course, responsible for it. Through this method we not only get better maintenance of the machine, but we think we also get better operation of it, because there are some peculiarities to every machine, and if the same man operates it at all times we are certain to get more efficient use.

In the case of a small machine which does not warrant sending a man along with it, when it leaves each gang, a report is made on the condition of the machine when it leaves a gang, a copy being sent to the chief engineer and to the division engineer of the territory to which the machine is going. As soon as the machine arrives at a new location, a similar inspection report is made, and if there is any disagreement, the reason is traced very quickly. In that way we can be pretty sure that the man who passes on a piece of equipment will try to put it in shape before he ships it, or if the equipment is not in shape, that he will make a truthful report as to its condition.

It certainly is important to follow up the condition of machinery very carefully and to assign definite responsibility for it. If it floats around between several different operators without any definite responsibility, each fellow will "pass the buck" to the other, and the machine will not be maintained.

E. C. Neville (C. N. R.): Our large machines, such as air compressors, derricks, concrete mixers, etc., come under the direct jurisdiction of our superintendent of work equipment, who has operators that he can send out with them, provided the division on which they are to be used has no qualified person to operate them. As soon as a division is finished with a machine, it is sent back to headquarters, if it is not required immediately on some other division. As soon as the work is completed on any division and a machine is returned, a report is sent to the superintendent of work equipment outlining any defects, or any repairs that are required.

This applies to practically all of our heavier equipment, including sandblast machines, with the exception of paint-spray outfits, which are usually assigned to the paint gangs of the various divisions. We can usually find someone in these gangs that can maintain the paint-spray outfits satisfactorily. On my own territory I am fortunate to have an expert on the maintenance of these kinds of tools.

We have not used smaller tools, such as pneumatic tools, very extensively so far, but I recently had quite a job to do down at Niagara Falls, Ont., where I equipped the bridge gang with power tools for the framing of the ties for the large deck of the Whirlpool Rapids bridge. It was a rather complicated piece of work and the framing had to be done with particular care. Incidentally, you will find an article on this work in the current October issue of Railway Engineering and Maintenance, written by the Chairman of this committee,

which describes some of these tools.

One of the most important tools that I used on this work was the chipping hammer. I secured two small ones, striking 200 blows a minute, and equipped them with large chisels somewhat like an adz blade. We used a power hand saw for making our daps, and the men used the power chipping hammers with the chisels for adzing instead of hand adzes or adzing machines. I found the chipping adz a very economical tool. With it one man could do as much as three or four men with a hand adz, and of equal importance, he could do a perfectly smooth job. Using the tool, we can adz out almost as cleanly as with a plane.

The reason I mention this is because it is such a simple tool to handle. Where you have air, you can use it on almost any framing job, or you can devise other cutting tools to use with the hammer. I have found so much use for the hammer that I could not do without it now.

T. H. Strate (C. M. St. P. & P.): I should like to emphasize further the statement in the report concerning the use of automobile trucks for the handling of bridge crews, carpenter crews and material. That is something that can not be over-emphasized.

President Bechtelheimer: Mr. Kenney, can you say something about automobile trucks for the handling of bridge and building material?

W. K. Kenney (C. & N. W.): I agree with the gentleman from the Milwaukee. I think they are quite essential these days for handling bridge and building material, especially around large terminals. Our engineering department is using them to the limit, and it is certainly realizing on the investment in this type of equipment.

R. D. Ransom (C. & N. W.): I think that a few more meetings will bring out the fact that there should not be quite so much centralization of equipment. I believe there is a lot of lost time in shipping tools. We don't have a considerable amount of work to do, we don't ask for special equipment, we go ahead and do it by hand. If each gang was better equipped locally, this work would be done with suitable tools, and would thus be done more economically. In other words, I am a firm believer in a little more equipment and the greater economy that would result.

J. A. Jorlett (Penna.): I would like to ask members from those roads that are using trucks to take care of their men, whether it is the practice to assign trucks to one gang exclusively, or to use the trucks in a pool?

Mr. Crites: On our large terminal at Baltimore, Md., it was found expedient to employ a truck dispatcher. The orders had to come to the truck dispatcher the day before the trucks were needed, so that he could plan the dispatching of the trucks for all departments and for all classes of work. He would notify each outfit that a truck could or could not be provided for the next day, so they could plan their work accordingly. Of course, this applies to large terminals and would not apply to isolated places where a truck would be assigned to a particular gang.

President Bechtelheimer: The report mentions that the bridge

gangs of a southern road have a certain specified list of tools. I would like to ask the committee why air drills are not included in that list, along with busters and pneumatic hammers? It would seem to me that with the latter equipment an air drill would be necessary.

Chairman Dick: Mr. President, I don't think the committee can tell exactly why this particular railroad does not include air drills in the equipment of its gangs. It would seem that, judging from the type of equipment they have, these gangs perform work on steel bridges, and that, therefore, to leave drills out of the list is something of an omission. Apparently, they should be included.

President Bechtelheimer: There is another point in this regard that interests me. All of the drills furnished our steel gangs are non-reversible. I am just a little confused as to whether reversible drills are used with our timber gangs, and whether we are alone in using non-reversible drills with our steel gangs. I would like to have someone clear this up for me. Are there any steel men here? (No response.) The question will have to go unanswered, and we will have to close the discussion at this time.

Mr. Dick, this association gives your committee high praise. I extend to you and its members our appreciation. The committee is discharged with the thanks of the association.

The Repair and Renewal of Ballasted-Deck Bridges

Report of Committee

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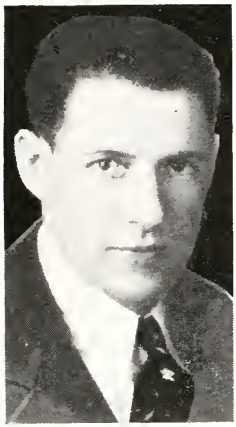

W. A. Sweet
Chairman

Major reference is made in this report to treated wood bridges and trestles. Ballasted-deck pile trestles were first erected about 40 to 45 years ago and were expected at that time to have a life of 25 to 35 years. Many structures have already greatly exceeded that expectation and some of them will, no doubt, give 50 years of service.

This type of structure has proven very satisfactory, both because of its low maintenance cost and because of the improved riding qualities which it affords. Countless bridge structures now in service indicate that a ballasted-deck pile trestle requires very little maintenance for many years following its construction. However, due to differences in the quality of the timber used, combined with construction defects, such as the improper treatment of field cuts and bored holes in piling and decks, many of the earlier bridges of this type are requiring minor repairs to obtain the full life of the structure as a whole.

The first ballasted-deck pile trestle built on the Santa Fe was driven during the winter of 1898-1899. This structure is being renewed completely during the present year after being in service nearly 42 years. As built originally, this bridge consisted of 73 bents of five long-leaf yellow pine piles per bent. The deck material was of Texas pine; the caps and main stringers were 12-in. by 12-in. timbers; while the outside stringers were 10-in. by 10-in. timbers. All material received a 10 or 12-lb. full-cell treatment of creosote oil and good penetration was obtained.

Repairs made to this structure in the past consisted of renewing about 48 per cent of the original caps. The necessity for changing these caps was due partly to the fact that the five-pile bents provided insufficient bearing area to carry the heavy power moved over the bridge, which resulted in some of the caps being crushed over the piles. Nine of the original piles were replaced and 11 helper piles were added. In 1937, two 12-in. by 12-in. by 14-ft. and seven 12-in. by 12-in. by 28-ft. stringers

were changed out. Considering that this bridge was designed and built 42 years ago, it is felt that very satisfactory service has been obtained from it.

When repairs to a ballasted-deck bridge become necessary, they present a much more difficult problem than do repairs to an open-deck bridge. To determine when repairs are necessary, and the extent of the repairs needed, calls for a careful and complete inspection by properly designated officers, preferably a general foreman or supervisor of bridges, and such others as may be required. The judgment of the inspectors, in addition to following fixed inspection rules, is usually sufficient in most cases.

Rules for Inspection of Treated Ballasted-Deck Trestles

Treated ballasted-deck trestles require very little inspection for a number of years after construction. Regular inspections are necessary, however, to insure against broken timbers and fire hazards, and to see that bents are not weakened by scour from flood waters. After about 15 or 20 years, it is well to determine the condition of the timber by sounding adjacent to the bearings with a hammer weighing about two pounds. Piling usually shows first signs of failure directly under the cap at the cutoff, resulting primarily from failure of the field treatment to provide adequate protection. Decay may also be found at brace bearings where holes, bored through the piles, were not properly treated. Piles may also be found decayed in the center, several feet above the normal water line, as the result of water penetrating to the center through weathering cracks during high water periods.

If sounding indicates that a timber is more or less hollow, a thorough investigation should be made with an auger or increment borer to determine its true condition accurately. If it is found that decay has already taken place, the degree of decay will determine the frequency of future inspections. If, on the other hand, the sounding test indicates sound timber, future tests may be made every three to five years until the sounding test indicates decay; then the boring test should be made.

Under usual conditions, a complete boring test of all timbers will not be necessary until the structure is about 30 years old. After such a test, all holes should be treated with hot creosote oil and plugged with creosoted wood plugs and sealed over with pitch or sealing compound. Timbers should not be examined with a pointed bar, as the use of such a tool will damage them. The heavy crust of creosote-soaked earth around piles at the ground line should not be disturbed, as this provides added protection at the ground line where decay usually starts.

Caps should be examined closely for splits, crushing over bearings and spreading. One should use a sounding maul and an increment borer when signs of decay are found. Crushing over the piles is quite often an indication of decay in the tops of piles, which reduces their bearing surface to a narrow ring or shell of solid wood which cuts into the bottom of the cap. Braces should be inspected along with other pile bent material. Where silt has been deposited around the lower ends of braces, they may be found decayed. The stringers on ballasted-deck bridges generally show first signs of failure at their bearings on the caps and directly under the deck boards. In decks having the solid-stringer type of construction, individual timbers will often warp or develop a perma-

nent set in the center of the panel, causing them to sag an inch or more lower than adjoining stringers.

When it becomes necessary to bore stringers for inspection, the holes should be bored from below insofar as possible to eliminate the possibility of their holding water. In some instances it may be necessary to remove the ballast and to bore through the deck boards into the stringers to determine their condition. All holes, whether bored from above or below, should be treated and plugged. A pressure gun is needed to treat properly vertical holes bored from below.

Wrought Iron Deck Plates are Being Installed by Some Roads With the Expectation That Longer Service Life Will Result

An accurate record of all timbers bored should be made and kept on file, both to determine the repairs necessary at the time the inspection is made and for reference in making future inspections.

Other Types of Ballasted Decks

After about 25 years, depending somewhat on drainage conditions, the timbers of ballasted decks on steel spans may begin to show decay and crushing over the bearings, and weakness under traffic. The timbers should then be bored from below at about a 45-deg. angle over the bearings, because any decay in the timbers will usually be found at these points, especially if they have been gained out for rivet heads and were not properly treated where cut. Decay may also be evident around the hook bolts attaching the deck timbers to the steel. On some decks it may be necessary to remove the ballast in places and make the inspection from the top.

In the case of concrete ballasted decks on steel spans and concrete ballasted-deck bridges, the parapets usually deteriorate first. This deterioration, as well as that on the bottoms of the slabs, which usually is next in order to appear, is easily detected and can be followed closely at the time of the regular masonry inspections. Discoloration is an indication that water action is taking place within the body of the concrete. A clear ring of the concrete resulting from a sharp blow with a hammer is a good indication of soundness.

In the case of steel plate ballasted decks, to guard against warping or buckling and eventual rupture, the side plates should be designed for the vertical and lateral loads that they must receive through the ballast. Steel plate ballasted decks ordinarily do not require attention or inspection for serious corrosion until 25 to 30 years after installation. Then the ballast should be dug out at a few

points and the bottom plate inspected. The necessity for watertightness may require a much earlier inspection and repair date. Wrought iron deck plates are being installed by some roads with the expectation that longer service life will result from this material than from the steel so generally used.

A structure should be carried with repairs just as far as such repairs can be justified economically and consistent with safety. The location of the structure and the traffic which it carries are factors which must govern the situation to a great extent. Reports from several roads indicate that all ballasted-deck pile trestles renewed to date were renewed because of the condition of the substructure rather than the condition of the deck. Therefore, every means should be employed to keep the substructure safe until the longest possible life is obtained from the superstructure. It seems to be generally agreed that treated material, either new or good second hand, should be used, except perhaps in making temporary repairs, pending complete renewal within the near future.

The repairs most generally found necessary will include the occasional renewal of a cap or two; double-capping to obtain good bearing on piles which have become hollowed out by decay; the reinforcing or renewing of defective stringers; and repairs to bents. Repairs of the latter type can be made by cutting out defective piles and replacing them with posts resting on the pile stumps, or, by placing frame bents where conditions warrant, using either squared timbers for the new bents, or making the framed bents from the sound piles that remain and other piles or timbers added to complete the framing.

The substructure can often be greatly stiffened by placing additional bracing and by the use of Teco Timber connectors between the piling and bracing. These connectors are being used quite extensively by many roads. Those used most frequently in trestle bracing in reconstruction and repair work are the toothed-ring type and the flat and single-curve spike grids. These are used mainly to increase the efficiency of the bracing. One road has used toothed rings in placing stub piles in ballasted-deck bridge repair work.

The Chicago, Milwaukee, St. Paul & Pacific arrests checks in caps by the use of Giant Grip dowels driven into the caps. It also makes repairs to broken stringers by placing a helper stringer on each side, and securing the three pieces together with Giant Grip dowels.

Outside stringers are renewed in kind. In changing a cap in a ballasted-deck bridge, especially one with a solid stringer floor, great difficulty is generally experienced pulling the drift bolts that hold the stringers to the caps and the caps to the piles. Some roads have devised other methods of anchoring the caps to the piles and the stringers to the caps, eliminating the use of drift bolts, which, no doubt, greatly simplifies the work when repairs become necessary.

Partial renewals of ballasted decks on steel spans and timber trestles alike are obviously so uneconomical that they should not be considered. Many decks have been in service 35 years or more without repairs, and when repair becomes necessary, complete renewal should be made. The necessity for complete renewal may differ to some extent for each structure and be affected by the conditions surrounding each particular structure and the traffic it has to carry.

While decay in the timber is the most frequent reason for the complete renewal of a bridge, increased live loads, in many cases, may have to be considered also. A study of the following factors should be made to determine the proper time for complete renewal: the physical condition of the timber; necessity for a structure of higher rating; the cost of extensive repairs; and the cost of the new bridge. A high trestle across a stream subject to flood waters cannot be carried safely for as long a period as a low structure in a location not subject to such conditions.

Making a Complete Renewal

The procedure for making the complete renewal of a ballasted-deck bridge depends to a large extent upon traffic conditions. If the structure carries a track that can be taken out of service, the procedure will be the same as for constructing a new bridge. Where traffic must be maintained, the best procedure is to first remove all of the ballast and all of the stringers except eight of the best ones, which should be placed four under each rail, forming two chords. The stringers in each chord should be bolted together to prevent their shifting or spreading. Blocking should be placed between the ties and these chords, using old stringers placed longitudinally directly under the rail.

Before starting the driving of the piles for the new bridge, the bents should be carefully staked out to insure the proper spread of piles in the bents, as well as accurate lengths of the panels. Holes should be bored in the ground sufficiently deep to insure holding the piles in line in the bents. After the piles have been driven and the bents cut off and capped, a number of panels of the old deck should be removed and the deck of the new bridge placed. The length of deck to be changed at one time depends upon the time available between trains.

Changes in the grade of the track and in the depth of timber in new decks will sometimes make a difference in the procedure, which will have to be worked out to the best advantage for each case. The Missouri Pacific advises that all decks for bridges more than three panels long are constructed on a temporary support adjacent to the old structure and are then jacked under the track after the old deck has been removed.

Treated Ballasted-Deck Bridges, Built to the Highest Standards, Will be Good for at Least 50 Years, According to the Committee

In this method, they report a saving in labor costs as well as less delay to train operations.

Renewals on Steel Spans

In renewing timber ballasted decks on steel spans, first remove the ballast curbs so the deck timbers can be removed, without attempting to salvage the old ballast. As the old deck is removed, lay the new timbers immediately and bolt them in place. Block the track up with sawed ties or with the old deck timbers removed, placing them longitudinally under the track ties, one line under each rail. Dump new ballast and surface the track. As all of this work has to be done between trains, the time available will determine the number of feet of deck that can be replaced at one time. It is not essential that the new ballast be dumped before letting trains over, as the blocking ties or timbers under each rail will carry the track. A power crane should be used to handle the timber and the ballast.

The Milwaukee reports that employing this procedure on a number of jobs where concrete slab ballasted decks were being replaced with creosoted timber decks, they found that it requires an average of 1¼ man-hours per foot of deck to remove the old concrete slabs and 3 man-hours per foot to place the new deck.

Most roads make no special provisions for the drainage of ballasted-decks of trestle bridges or of timber decks on steel spans, other than to allow ⅛- to ¼-in. openings between deck boards to allow water to drain through. The Santa Fe places 13/16-in. wood shims under the ballast curbs at each bolt location to allow water to drain out. The Missouri Pacific uses a similar plan.

Drainage systems in concrete-slab and steel-plate ballasted decks have not proven satisfactory in many cases, generally because weep holes become clogged. A number of roads, in the case of steel-plate ballasted decks, are now using a half-round perforated drain placed longitudinally along each side of the track, sloped laterally and longitudinally to the track. On buckle-plate ballasted floors, where weep holes have become clogged, the openings can be enlarged to a drain of 2½ in. to 3 in., and special drain castings installed.

Effect of Ballast Lift

Some roads have disregarded the possible overloading effect of the increased dead load due to a ballast lift and consider this of little importance in relation to the steadily increasing live load. In connection with this question, a review was made of the design for the standard pile ballasted-floor trestle used on one of the western railroads. The design data for this trestle as designed originally (1910-1911) were as follows:

Live load on bridge—E-50; Dead load 2200 lb. per ft. of track.
Ballast—Screened stone; depth 1 ft. 2 in. below base of rail.
Ties—6 in. by 8 in. by 8 ft., spaced 1 ft. 6 in. centers.
Timber floor planks—3 in. by 8 in. by 14 ft., with ½ in. space between planks.
Intermediate stringers—8 in. by 16 in. by 14 ft. 6 in., eight stringers per track.
Outside stringers—6 in. by 16 in. by 14 ft. 6 in.
Guard rails—8 in. by 8 in., separated from floor planks by cast iron separators 1 in. thick, 5 in. wide—three separators per span.
Caps—12 in. by 14 in. by 16 ft.
Piles—6 per bent, 13 ft. 6 in. c. to c. of bents.
All timber creosoted.

In this review of the design, the original E-50 loading was assumed with the longitudinal distribution of

live load over two ties and transverse distribution over 9 ft. 2 in. This distribution was used for figuring loads on the floor planks. No allowance was made for impact.

The effect of additional ballast 12 in. deep, or a total depth of 2 ft. 2 in., was considered as applied to different members of the trestle. The results of the review of design are given in an accompanying table, which shows that additional ballast, 12 in. deep, produces stresses in the stringers and piles that approach their limits. The stress in the stringers reaches 1600 lb. per sq. in., which is equal to the allowable working stress of 1600 lb. is shown in the case of the trestle reviewed in the foregoing.

The proper solution for the lift of the ballast seems to be in limiting the increased depth of ballast to an additional height of not more than 12 in. If there is need for an additional raise of the grade of the track over the bridge, the additional raise can be secured by providing shims or false caps at the bents. This procedure will not put additional overload on the bridge. It is realized, of course, that to place false caps for a bridge of considerable length will call for jacking up the spans for the entire length of the bridge, a procedure that may cause delay to traffic.

Increased Stresses in Trestle Members Due to a 12-in. Ballast Lift

Members	Size of Timber		Original Design L.L. = E - 50 Ballast = 1'-2"		Reviewed Design L.L. = E - 50 Ballast = 2'-2"	
	Nominal	Actual	Unit shear	Fiber stress	Unit shear	Fiber stress
Floor plank	3"x 8"	2¾" x 7½"	53 #/□"	515 #/□"	56 #/□"	642 #/□"
Stringers	8"x 16"	7¾"x 15¾"	113 #/□"	1460 #/□"	123 #/□"	1600 #/□"
Caps	12"x 14"	11½" x 13½"	89 #/□"	800 #/□"	97 #/□"	990 #/□"
Piles	6 Piles per bent		Load per pile = 13.4 T.		Load per pile = 15 T.	

per sq. in. for select grade Douglas fir, ordinarily used for stringers. The load on each pile reaches 15 tons. This higher loading may be allowed on the piles, depending upon their bearing capacity, determined by test, and upon their penetration.

Railway Engineering and Maintenance Cyclopedia, Page 503, refers to some cases where the depth of ballast on bridges, acquired through successive lifts over a period of years, has reached a depth of 4 ft. This depth of ballast surely is excessive, and that it produces stresses considerably above the allowable working stresses for structures designed for 14 in. to 18 in. of ballast. However, safety, as measured by the strength of the members of a bridge, may call for the adoption of this procedure instead of putting additional extra ballast on a bridge.

Make necessary repairs to old structures to insure safety until renewed, using treated material, either new or good second hand.

In making bridge renewals, select materials carefully. Use preframed timbers in so far as possible. Eliminate all unnecessary holes or drift bolts. Give special attention to the field treatment of all cuts and holes. If these measures are followed, ballasted-deck bridges constructed today will be good for at least 50 years.

DISCUSSION

President Bechtelheimer: Mr. Sweet, Mr. Byrd and your committee, your report is timely. It covers the subject completely and will be a great help to all supervisors and other officers confronted with the maintenance of ballasted-deck bridges. I hope our members who came to the convention last year seeking information on this subject are here today to join in the discussion.

I wonder if Mr. Van Ness, of the Santa Fe will come to the microphone and lead the discussion on this and some of our other bridge problems?

R. A. Van Ness (A. T. & S. F.): I don't think there is much I can say that would improve on what Mr. Sweet has already told you. There may be some questions in your mind that he hasn't discussed, and if there are, I will be glad to do what I can to answer them.

S. T. Corey (C. R. I. & P.): We have a problem on our railway. We have some very long panels in our bridges. We use 8-in. by 16-in. stringers and nine of them are provided to carry the load. How are we going to strengthen these bridges without spending any money on them? As I have already said, the size of the stringers is 8 in. by 16 in. and they are interlaced over the bents. Of course, we have thought of putting some timbers in between them. The trouble is, we would have to cut off the ends of the present stringers at the laps.

Mr. Van Ness: How long are your longest panels?

Mr. Corey: Some are 14 or 15 ft.; some may be 16 ft.

Mr. Van Ness: How many 8 by 16's under your track ties?

Mr. Corey: Of course, there is an 8-in. space between stringers. The ties are 9 ft. long. I am inclined to think that the outside stringer of the group of nine is out beyond the end of the ties. The floor boards might distribute some of the load laterally to the outside stringers.

Mr. Van Ness: On top of the stringers you have 4-in. by 8-in. floor boards?

Mr. Corey: We have a 3-in. by 10-in. solid floor.

Mr. Van Ness: Mr. Corey asks a question that hit the Santa Fe some years ago, where a dry atmosphere bleached out the creosote and the timbers went to pieces pretty badly. Mr. Corey has stringers which have a certain space between them and a transverse floor of 3-in. by 10-in. timber across the top.

In our case, we found that we could not depend much on stringers outside of the ends of the ties. Therefore, we generally get 8 stringers on 14 and 16-ft. panels, center to center of caps. Where we operated our heavy engines, we were finding stringers breaking right along. There wasn't much we could do because we had a transverse floor. It practically meant taking up the floor and renewing enough stringers to get the strength required. So we took out all of the stringers and put in 5 stringers (7-in. by 16-in.) per rail, and then one stringer in the middle and two on the outside to take care of curves. This gave us a 15-stringer deck. It was a rather expensive procedure, but we knew of

no other way to rearrange or strengthen the existing stringers in those types of decks to prevent breakage under our traffic.

Of course, that isn't what Mr. Corey wants to know. He wants to know how he is going to take care of his situation without spending any money.

Mr. Corey: Just as a suggestion, I have revolved in my mind the possibility of applying some additional timber on the bottoms of the existing stringers, but the difficulty is in taking care of the longitudinal sheer. How could we fasten, say, a 4 by 8 or a 3 by 6 to the bottoms of the present stringers and have them act as homogeneous beams?

Mr. Van Ness: Has anyone any thoughts along that line? It might be you could use timber connectors. That might help take care of the sheer. I suppose, however, cutting the fibers with those is not so good.

F. R. Spofford (B. & M.): Our road has a large number of composite stringers in which we use the old type of cast iron key, with bolts on each side of the key. They have been very effective. In many timber truss overhead bridges where the key is set in at the ends of the bottom chords, we have had occasion to use scabbard pieces outside as a temporary expedient. In such cases, instead of using timber keys or the usual metal keys, we have had success with various types of alligator or split-ring connectors. I think possibly, the use of timber connectors, as you have mentioned, would develop the horizontal sheer that is necessary to make the extra timber effective.

Mr. Van Ness: The only objection I can see to the alligator ring is the fact that you cut the fibers of the existing stringer, which would tend to weaken it somewhat —up to the depth of the alligator appliance.

Mr. Corey: You can't forget the fact that you have shearing stress. It would have to be something to take up the stress continuously as you stress across the span.

Mr. Van Ness: In Mr. Corey's case, I think his suggestion of putting a 3 by 8 on the bottom of the stringers would be well worth trying.

Mr. Corey: I wonder whether spiking would be effective, and whether spikes would hold?

Mr. Van Ness: Mr. President, I think Mr. Sweet's paper was a very fine one. I like the idea of draining the decks, like he mentioned. I think that is well worth while. Keeping down on the depth of the ballast is something that we are continually watching. I think that is well worth while also.

Armstrong Chinn (Alton): Mr. Van Ness, I note some comment in the report on the use of wrought iron deck plates on steel bridges. We have used them in a few instances in grade separation projects, particularly where we were pinched for clearance beneath the bridge. But I have been disappointed in the results. No matter how carefully we have applied and welded these plates, they have pulled apart in some manner and all of the decks leak to a greater or less extent.

I would like to hear you say something about your experience with wrought iron deck plates and what you think of them.

Mr. Van Ness: We applied our first steel plate deck about eight or

nine years ago. We haven't used wrought iron; we used copper-bearing steel, because we make the plate an integral part of the stringers where they are mostly transverse. By welding sufficiently under the flanges of the transverse beams, we feel sure that we derive some value from the plates.

So far we haven't found any leaks in our decks. Your trouble may be due to the fact that wrought iron, as we know, will pull some in welding because of the inclusion of slag in the metal.

Mr. Chinn: We applied our deck plates a little differently. We welded the wrought iron plates together somewhat like a trough; then set them on the floorbeams and welded them in place. I imagine the heat of welding distorted them somewhat. Anyhow, there was a certain amount of buckling; they pulled loose and leak to a certain extent.

Mr. Van Ness: There is one thing that we do require: that the contractor or our own men tell us just how they intend to keep the plates down while they are welding them to the beams below. We make them tell us what procedure they expect to follow. We add $\frac{1}{8}$ in. to the plates for the future corrosion that we know will take place, and then we put a heavy coating of petroleum on them. We have had occasion to dig into some of these decks that are four or five years old and there has been no corrosion yet.

K. L. Miner (N. Y. C.): I would like to ask Mr. Sweet what tool he uses to treat the holes in the timber that are drilled in the field.

Chairman Sweet: We use a pressure-type gun for filling them. We use it to some extent on the larger square timbers as well, such as caps, if necessary. The device is in two pieces. One piece that we screw in from the opposite side; just a threaded rod with a handle on it, which seals that side. Then we screw the other section, which is the gun, in from the other side. The gun has a plunger with a valve mechanism in it. You pour the creosote into a little cup that is on the gun; then, by working the handle back and forth you can put considerable pressure on it. I forget just what pressure they claim is possible, but you can make the creosote come out the end of a cap when the hole is several feet away from it, by putting pressure on and then leaving the two tools in place for a few minutes, while the hot creosote has time to penetrate.

For treating test holes bored into a stringer from below—possibly that is what you had reference to—we use the same procedure: something that will put the creosote up there under pressure and hold it there so that we know it reaches the top of the hole. You can hardly do it by swabbing. You get more up your sleeve than you do in the hole, if you try it without a gun.

Mr. Miner: Do you feel that it is worth the expense to treat these holes?

Chairman Sweet: I do, because we bored timbers in several old structures where we thought we had a pretty bad condition, but in boring we found innumerable timbers which were just as sound as the day they were put in. We know that whether that timber stays in the bridge or whether we reclaim it at some later date for use elsewhere when the bridge is renewed,

or use it for repairs, it is just as important to take care of that hole as though the bridge was to be taken out this season. That is my thought on it, and it is our practice.

Mr. Chinn: Mr. Sweet, under that part of the report dealing with a complete deck renewal, it is stated that before starting the driving of the piles for the new bridge, the holes should be bored in the ground sufficiently deep to insure holding the piles in line in the bents. Do you have a machine for boring these holes, or do you follow the method that I have always followed—use a spade?

Chairman Sweet: I think that your method is ours in most cases, although we do use a post hole auger or a digger of some sort. The committee used the words "boring holes" because it seemed to describe the hole we want a little better than to say "digging the holes."

Mr. Chinn: There is a new hole borer being marketed and I thought that was the machine you were referring to.

Chairman Sweet: No, we have not used that type of machine for this purpose, and it was not mentioned by any of the committee members that such a machine was being used. However, in some locations, one of those machines could be used to good advantage if you have a place where you can drive in with it. As I understand it, these machines are automobile-mounted, and I see no reason why they could not be used at suitable locations.

R. E. Caudle (M. P.): You spoke about treating bored holes with a pressure gun. I would like to know how you keep the creosote from getting out where you have two thicknesses of timber? Also, when you insert the pressure gun, how do you keep the creosote from flowing out and not penetrating the timber?

Chairman Sweet: We accomplish that in two ways, Mr. Caudle. In sway-bracing, we put the sway brace into position. We have a prebored hole in the caps which allows us, by boring one hole in the brace, to hang the brace in place. Then, after boring all of the holes, the brace can be slid back, swung out of the way temporarily, and the holes treated. The creosote gun has a shank 8 or 9 in. long, with three or four threads near the end. The intent is that you screw the shank on through the sway brace and into the pile, and get past the brace before starting to pump creosote. Unless that is done, it is impossible to get any pressure on the pile hole.

We find it a little faster to bore all sway-brace holes; move the brace back out of the way; treat all of the holes in it; and then put it back. Generally, our sway braces are treated all of the way anyway, and we don't feel that it is necessary to make a special set-up to treat holes bored in them.

President Bechtelheimer: Has someone an experience to relate regarding the use of special anchorage to eliminate the drift bolts that are so commonly used to fasten the caps to the piles and the stringers to the caps, so that when you want to renew one or the other of these, it can be done without tearing the bridge to pieces?

L. G. Byrd (M. P.): We have eliminated the hook bolts entirely. In open deck and ballasted-deck bridges we use angle irons. These

irons are ⅜ in. by 2 in. by 3 in., by 15 in. in length, which are bolted to the pile and cap. We use a ¾-in. bolt. All of our caps are preframed for anchorage corners. We sort of stagger them through the bents. With six-pile bents, we use four to the bent. We figure that the bracing will take care of the outside piles and will hold them in line.

W. Walkden (C. N. R.): In the Canadian National design, there is no vertical anchorage whatsoever. The stringers are arranged in pairs, with a splice timber between them, which passes over the cap. The splice timber is opened horizontally so that it exactly fits the cap. That gives horizontal anchorage, but there is no vertical anchorage whatsoever.

President Bechtelheimer: What about the fastening of the cap to the pile?

Mr. Walkden: The cap is drifted to the pile.

President Bechtelheimer: Between each pair of stringers you have a filler and you bolt through them to tie your chords together horizontally, making a more or less continuous beam of the stringers, and have no vertical anchorage?

Mr. Walkden: The splice is a 4-in. by 16-in. timber, 4 ft. long. There are two bolts on each side of the cap.

President Bechtelheimer: We use something similar to that on overhead highway bridges.

G. E. Boyd (Ry. Eng. & Mtce.): With the increasing speed of both main-line freight and passenger trains, and with the continued extension of these high-speed trains to other lines, it is becoming more and more important to eliminate slow orders. A number of roads are now renewing open-deck trestles without putting on slow orders. I wonder if that is possible with ballasted deck bridges?

Mr. Byrd: I believe it would be practically impossible to renew a ballasted-deck bridge without slow-order protection; that is, without a slow order for a short period. We have renewed several ballasted-deck bridges this year with lengths from three panels to 500 ft. The 500-ft. trestle required 145 min. to jack it into place. A slow order was on for three days, due primarily to the servicing necessary after the deck was placed on the new bents. In the case of smaller bridges on some lines, we don't put on a slow order, but finish the job between trains. Of course, where trains are frequent, we would not be able to do that.

We also find a great saving and speeding up of the work in using the sub-jacking method. It reduces slow orders materially. The saving in labor cost in the construction of a bridge, using this method, is from 5 to 20 per cent.

Chairman Sweet: I might cite the case where we recently changed the deck on a deck plate girder bridge. It was a different type bridge than the one Mr. Byrd has referred to. He was speaking of ballasted-deck pile trestles.

We had occasion to renew the deck timbers on a 160-ft. ballasted-deck plate girder bridge, with three girder spans. While we did not accomplish it without a slow order, we thought we were getting close to it. We had five hours in which to do the work, with the assistance of a couple of track gangs that handled the disconnecting and re-

building of the track. First we completely removed the track and deck from this bridge; then cleaned the top cover plates and applied non-drying paint; and then put in the new timbers and bolted them down. We had our hook bolts already in place in the timbers; brought them in in bundles with a crane; and laid them.

We had planned to block under the ties, but after the work had progressed about an hour and a half, we were so cocksure that we were not going to need blocking that we eliminated it and just rebuilt the track on the deck. We had a work-train in the vicinity, going from one job to another, and arranged for it to be there at the proper time to bring in and dump a couple of cars of ballast which we had setting in on a nearby siding.

The track forces made the second lift on the bridge before No. 5 passed at 11 o'clock, and while we had a slow order of 10 miles an hour on for that train, as soon as it had passed we raised the order to 30 miles an hour, and that was the speed allowed the rest of the day. The second day we removed the slow order entirely.

Mr. Chinn: How long was the bridge, Mr. Sweet?

Chairman Sweet: It was 160 ft., comprising three girder spans. We had a little leeway, though. If we got caught, we figured we could stop without working on the third span. But the work progressed so rapidly that we removed the entire deck and replaced it, dumped the ballast, and had the ballast curbs on by noon, which is about the nearest to getting a job done without a slow order that I believe is possible.

J. A. Jorlett (Penna.): In the report you say that the Milwaukee has employed this procedure on a number of jobs where concrete slab ballasted decks were being replaced with creosoted timber decks. Do you care to say why the concrete ballasted decks were removed, if you happen to know?

A. B. Chapman (C. M. St. P. & P.): The concrete slabs were removed because of deterioration of the concrete. Satisfactory strength was no longer there.

Mr. Jorlett: The concrete deck had failed then?

Mr. Chapman: The concrete deck had failed. It was heavily reinforced. Failure was due to water going through the concrete.

President Bechtelheimer: We will have to go on to the next report, unless you have something more to say, Mr. Sweet.

Chairman Sweet: There is just one thing more that was not mentioned in connection with hook-bolt or other methods of anchorage. These other methods have all been applied to those decks that have some space between the stringers. I don't know of any method that has been used on a solid timber floor other than the use of hook bolts. I really don't know whether there is any other way that could be worked out satisfactorily.

President Bechtelheimer: I discharge the committee with the thanks of the association.

B. & B. and P. & S. Departments Must Co-operate

By H. R. Duncan

Superintendent of Timber Preservation
C. B. & Q., Galesburg, Ill.

(Introduced by Elmer T. Howson)

H. R. Duncan

Elmer T. Howson: Those of you who have been chairmen of program committees for conventions know the fun you get when you receive a telegram reading like the one I received yesterday: "Because of important matters demanding my attention, it will be impossible for me to attend the meeting on Wednesday. I hope it will not inconvenience you to fill the Wednesday program.

R. D. Long."

That is the type of message that one doesn't like to receive and yet, those of us who know Mr. Long know that it is no minor conflict that has kept him away, because he is very much interested in our group.

Yesterday afternoon I called his assistant, Joe Blum, and said, "What are we going to do?"

Joe replied, "I don't know."

I said, "How about you coming over to fill the bill?"

He said, "I can't come—I never made a speech in my life"—but, characteristic of the organization of which he is a part, he continued, "we are going to see that you are not left in a hole. We have some men in our department who can make speeches so you need have no worry."

The Burlington has delivered, and has a fine representative here. I know that he can talk, because I have known him for many years. He has been president of the American Wood Preserver's Association. Before he went into timber preservation for the Burlington, he was one of its system officers in the stores department, so he knows store department work, and in the treatment of timber he has had day-to-day contact with bridge and building men.

He is going to pinch-hit for Roy Long. He did not know this until seven o'clock last night. He is presiding at a meeting of the Wood Preservation committee of the A.R.E.A. today, but in spite of that responsibility, and in spite of the inadequacy of the notice given him, he is going to hold a little staff meeting here to tell you of some of the things that come

across his desk, and that come across the desks of the other men in the stores department of the Burlington as they receive and fill requisitions in an endeavor to meet the needs of the bridge and building men.

Harry Duncan is going to pinch-hit for Roy Long. I am highly pleased to introduce him to you.

Address by Mr. Duncan

In the proper handling of bridge and building department materials and supplies, there must, of course, be co-operation both ways between the bridge and building department and the purchasing and stores department, and that is how we try to operate on the Burlington. In developing figures of the material requirements on our property, the bridge engineer secures estimates from the division officers about two years in advance in the case of piling and lumber. These estimates, of course, cannot be accurate, but they are the best that anyone on the railroad has of what we are going to need. This information is given to the purchasing and stores department in order that it can prepare orders, secure the material, season, frame and treat it, and have it ready for shipment prior to the time when it is actually needed.

Each year, usually during the months of September, October and November, our bridge engineer, with a party of officers and assistants, makes an inspection of all bridges on the railroad. At this time, he details definitely what each bridge needs, and when he has finished his inspection, he gives us a statement of what his material requirements are going to be for the following year. Thus, we get two estimates—one, a preliminary estimate, about a year and a half or two years ahead of actual requirements, and then a very definite estimate, usually about the first of the year. Prior to the receipt of the definite estimate, we have purchased much of the material required. After the bridge program has been developed and approved, the bridge engineer prepares requisitions for each job. These are given to the stores department, making a definite commitment, and we then proceed to get the material ready, but we do not ship it until we receive definite instructions.

We usually receive practically all requisitions by shortly after the first of the year. The bridge engineer keeps in touch with the field forces over the railroad, gets reports from each pile-driver crew, knows definitely what progress is being made on each job, and shortly before the material is actually needed, he notifies us that he wants the material at a certain point on a certain day. When he has done this, he has finished his part of the job of co-operation, and ours begins. Then it is up to the stores department to have the material on the job by the time specified. As the result of our effort to co-operate with the bridge and building forces, I am sure that our performance in getting materials to these jobs when needed is very good. We know very definitely

that when we get a requisition from our bridge engineer and he says that he wants certain material on a certain date, that he really wants it. Therefore, we put forth every effort to get it there.

There are those in some departments on the railroad who are not as considerate and precise as our bridge department. To them, every job is a rush job; they want everything shipped right away. It is needless for me to say that these men do not get the attention and consideration that the man does who plans his work and tells us what he wants so that we can be prepared. I cannot say enough for the way our bridge department plans its work.

There is another important question in the relationship between the bridge department and the purchasing and stores department and that is the handling of emergency stocks. We have small emergency stocks at each terminal, far smaller than are found on many railroads. Our bridge engineer has figured out quite carefully the minimum amount that he can get along with at each point. We do, however, have large stocks—not emergency, but regular stocks—at our treating plants at Galesburg, Ill., and at Sheridan, Wyo. When a sizable emergency arises, these plants are notified and proceed to load up a lot of necessary material promptly.

I was on a trip West a few years ago when a large part of our railroad was washed out. When I reached home I found that on the first day we had loaded something like 65 cars of piling out of storage. Two days later, we were still loading, in spite of the fact that loading had been continuous day and night.

Another thing that the stores department does when we have a serious disaster on our road, and we have had a couple such disasters during the last 15 years, is to send men from our organization out on the job. We don't wait until they call on us and tell us what they want. These men sent stay on the job, and thus avoid a lot of red tape. The bridge department tells us what it wants and when it should be there, and, if necessary, we send material out in passenger trains. We have actually moved piling from Chicago to Thermopolis, Wyo., in less time than you can go on a passenger train.

President Bechtelheimer: Mr. Duncan, we are indebted to you for taking Mr. Long's place on our program and for giving us a good outline of what is required in obtaining materials for bridge and building work. We also appreciate the attendance this morning of the members of your committee of the A.R.E.A.

The Storage and Delivery of Bridge and Building Material

Report of Committee

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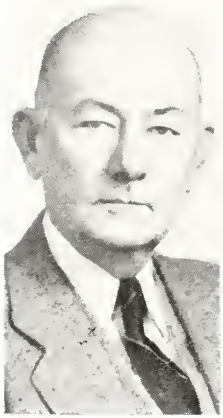


R. E. Caudle
Chairman

The report of this committee is based upon information furnished by its members, supplemented by additional information secured from a large number of railroads throughout the country, in an effort to obtain a nation-wide cross section of the usual methods of handling bridge and building materials. To secure this latter information, a questionnaire was forwarded to maintenance officers on 65 railroads in the United States and Canada, with a total of 223,000 miles of lines. Replies were received from 24 roads well distributed throughout the country, with a total mileage of 120,000 miles. Therefore, it can be assumed that the information furnished and forming the basis of this report is representative of present methods and practices employed in the storage and delivery of bridge and building materials generally.

The information obtained from the various railways under the several subheadings of the questionnaire is summarized in the following:

(1) Storage of Materials—Twenty roads, representing 94 per cent of the mileage reporting, store their bridge and building materials at central points. Four roads use local storage yards.

(2) Control of Materials—The stores department controls the materials on 20 roads; the maintenance department on four. Seventeen roads, representing 65 per cent of the mileage reporting, furnish the stores department with forecasts of materials required on an annual basis, four on a semi-annual basis, while four other roads, or 30 per cent of the mileage, furnish no forecasts. Twenty-two roads, or 92 per cent of the mileage reporting, have experienced no delays to work on account of deferred material deliveries.

(3) Policing—All roads reporting provide adequate fire protection for material stored, both at central points and in local yards, by employing municipal and company-owned fire-fighting equipment, by providing clean sites, by installing fences, and, when necessary, by employing company watchmen. Twelve roads, representing 45 per cent of the mileage, report

some loss of materials from fire and theft.

The stores departments on 15 roads are responsible for the protection of materials while stored at central points and in local yards. Five roads divided this responsibility between the stores and maintenance departments. On four roads, the responsibility is entirely with the maintenance department.

On 16 roads, or 75 per cent of the mileage reporting, joint stores—maintenance checks are made "frequently"; on 2, such checks are made monthly; on 1, quarterly; and on another, annually. Eight roads report some loss of material on account of being kept on hand too long. The roads reporting losses feel that these losses could be reduced considerably, if not almost entirely eliminated, by a more intimate contact between the stores and maintenance departments.

(4) Emergency Materials—Twenty roads, or 94 per cent of the mileage reporting, keep emergency materials at strategic points. All roads keep them at division points. Five roads (of short mileage) keep them at central points. Eighteen roads report the stores department as controlling emergency materials. On six, such materials are controlled by the maintenance department.

Fourteen roads, or 67 per cent of the mileage reporting, keep an average of three spans of emergency materials on cars, with crews, at all times, while two roads keep five spans of materials with each pile driver. Ten roads keep from 5 to 20 spans of emergency materials at designated strategic or division points at all times. Fourteen roads depend upon drawing emergency materials, other than those kept with crews, from central storage points.

(5) Emergency Equipment—Twenty roads, or 94 per cent of the mileage reporting, store emergency equipment, such as pile drivers, derricks, hoists, and air and electric equipment, at central storage or division points when not in use by the crews. Four roads keep such equipment with the crews that use them at all times. Thirteen roads keep repair parts with their respective machines; two in local supply stations; six in stores; while three order repair parts direct from the factories. Thirteen roads report that they have no delays because of breakdowns; 11 report infrequent delays.

(6) Delivery of Materials—The stores department delivers materials to crews on 20 roads, or on 94 per cent of the mileage reporting. On four roads it is delivered by the maintenance department. No road reports shipping bridge and building materials in large quantities to local storage, to be reloaded subsequently for delivery to the crews as needed.

Nineteen roads, or 99 per cent of the mileage reporting, supply all crews with a limited amount of excess materials with which to make unforeseen repairs. Five roads (each of short mileage) do not so supply their crews. Trucks are used for the delivery of small lots of bridge and building materials to crews on 13 roads, or 60 per cent of the mileage reporting, with a considerable saving in time. Six roads use trucks for the delivery of materials in terminals, and find the practice quite economical. Five roads, or 35 per cent of the mileage reporting, do not use trucks, since they do not feel that there is any economy effected by their use.

"Local conditions, the amount of material involved, and the length of haul, are the determining factors in the use of work trains in lieu of way-freight trains in the distribution of bridge and building materials," say all of the roads furnishing informa-

tion. They advise that all materials delivered to jobs and not used are promptly returned to the stores or maintenance department central storage points unless they can be transferred directly to another job without creating confusion.

Recommendations of Roads

According to answers received under the last subheading of our questionnaire—Recommendations, all roads favor the storage of bridge and building materials at central points. Twenty favor its control by the stores department. Four prefer control by the maintenance department. Nineteen roads favor furnishing the stores department with annual forecasts of materials. Five (short lines) feel that forecasts should be furnished semi-annually.

Eight roads, or 43 per cent of the mileage reporting, expect the stores department to have materials on hand to meet all requirements promptly, regardless of conditions. Twenty roads expect the stores department to deliver materials to the sites where they will be used. Four prefer that delivery be made by the maintenance department.

All roads recommend giving full and complete protection to materials against fire and theft, by every available means, employing watchmen to protect materials that are stored in large quantities at the site where they are to be used.

Nineteen roads report that from three to four spans of emergency materials should be kept on cars with crews. These roads recommend that from 10 to 20 spans of emergency materials should be kept at strategic or division points, or both. They say that the use of these materials for other than emergency purposes should be prohibited.

Twenty-two roads recommend that emergency equipment be stored at division points when not in service with the crews that use them. Twelve roads favor keeping repair parts for emergency equipment with the machines. Eleven roads favor the stores department maintaining a stock, while one believes that it is best to order these parts direct from the equipment manufacturers when needed.

To supplement the foregoing information received from maintenance officers, the committee made a canvas of the stores departments of the various railways to ascertain the general opinion and recommendations of these departments as to the storage and delivery of bridge and building ma-

The Committee's Investigation Disclosed Widespread Use of Motor Trucks for the Delivery of Bridge and Building Materials

terials. Questionnaires were mailed to the general storekeepers of 65 roads, and answers were received from 24, with a total mileage of 117,000 miles. The information contained in these answers is summarized in the following:

Central storage points are used for the storage of bridge and building materials by 20 roads. Four of these points are controlled by the maintenance department. Twenty roads report that accurate forecasts of creosoted material requirements are furnished by the maintenance department on an annual basis. Four report that such forecasts are made semiannually; all of these roads say that the length of time of advance notice is entirely sufficient. Ten roads advise that two months is sufficient advance notice to procure untreated timbers; eight roads require three months; four roads require six months, and two say that they require 12 months.

On 13 of the 24 roads reporting, or 68 per cent of the mileage, the stores department is furnished by the maintenance department with a program of anticipated work on the larger improvement and replacement projects, arranged in order of precedence. All stores departments reporting advise that such information is, or would be, most helpful and convenient in arranging to have materials ready for delivery. Incidentally, they also say that in many instances this should result in a considerable decrease in the stocks of materials that must be kept on hand far in advance of the time that the various projects are to be undertaken.

Nineteen roads in the United States, totaling 88,000 miles, report an average bridge and building material stock (in 1939) of $5,044,000, with annual disbursements of materials amounting to $9,218,000. As a whole, these roads are holding their average bridge and building stocks to 54.7 per cent of their annual disbursements. In addition to centralized storage, 15 roads keep specific bills of emergency materials at strategic points, while 9 keep stocks at division points. The stores department controls these stocks on 20 roads and the maintenance department controls them on 4 roads.

The average value of emergency stocks held at strategic and division points is $2,700. The value of these stocks at 200 points on the 117,000 miles of lines reporting is $540,000, or 10.7 per cent of the total of the average stocks maintained. Emergency points are located at intervals of approximately 600 miles. Each central storage point serves approximately 3,000 miles of road (or less) depending upon the mileage of the property.

All roads report that excess or unused materials shipped to jobs are returned to central storage points unless they can be transferred to other jobs without creating confusion.

From the foregoing review of the reports received from the bridge and building and the stores departments of the various railroads, it is evident that the methods employed in the storage and delivery of bridge and building materials on the different roads is not at wide divergence. Each road has an established system for performing these functions. Each road is, beyond doubt, entirely satisfied with its methods. This is indicated plainly by the individual recommendations received from the different roads.

In view of these facts, the committee hesitates to make definite recommendations, but it feels free to make comments and to quote in part from replies made by a number of maintenance officers. It believes that if

these are considered without prejudice by the departments involved, they will perhaps serve as a nucleus to increase further the high efficiency that has been attained in the functions to which this report relates.

Quotations and Comments

"It may be observed that on this system the bridge and building department and the stores department are both sections of the operating department and are correlated sufficiently so that it is of little practical importance to the bridge and building department where the jurisdiction of the stores department ends." So states the bridge engineer of a 7,000-mile railway in the northwest.

"Fifteen years ago, our management went to centralized control of materials by the stores department. Many radical changes were necessary. The bridge and building and stores departments had the issue placed squarely before them with no opportunity for alibis. By friendly discussion and planning we have developed an excellent service that really functions. It fails only when some individual fails." This statement came from the general bridge inspector of a 9,000-mile mid-west system. "Piecemeal ordering of materials greatly increases the stores expense in handling, creates an abuse of car loading, and adds a burden to the operating department in switching and the movement of cars," this general inspector added.

The assistant bridge engineer of a 2,000-mile northwestern road wrote as follows: "After the completion of our annual inspection, about October 1 of each year, a list of the timber required is furnished the purchasing department by the chief engineer. The timber is then purchased, treated and placed in centralized storage. About June, direct shipments are made on requests received from bridge and building supervisors. All materials are received promptly when ordered, and without delay to the field forces, while formerly, considerable delay was experienced when storekeepers shipped materials from local yards. Flat cars should, by all means, be used for the loading of piles and heavy bridge timbers—for the safety of those employes who unload them, as well as economy."

"When two departments of a railroad fail to co-operate, the company is the main victim and the chief sufferer," states the assistant engineer of a 3,000-mile southern road.

The chief engineer of a 2,200-mile

Most of the Roads Questioned Recommended Storing Materials at Well Laid out and Equipped Central Points

road in the mid-west wrote—"An annual inspection is made by the general inspector, accompanied by the division supervisor and other division officers, after which, a carefully prepared work sheet is made for each division. This work sheet is submitted to the management and, when approved, the material is ordered. The work sheet is divided into items, properly numbered, and opposite each item is shown the date on which the material will be needed. The material requiring treatment is ordered shipped to the treating plant, which, in turn, arranges to furnish the various items on the dates required." Incidentally, this chief engineer reports a total annual disbursement of bridge and building materials to the amount of $702,350, and an average general bridge and building stock of $463,500, or approximately 64 per cent of the annual disbursement.

An 8,000-mile mid-western system states that a forecast of anticipated requirements for bridge and building materials is furnished, but is not considered accurate due to changing business conditions which materially control appropriations. This system disbursed $1,308,000 in bridge and building materials in 1939. Its average stock was $693,000, 53 per cent of its annual disbursements.

A 3,000-mile southwestern line advises: "In June and July of each year, the supervisors and inspectors make a preliminary bridge and building inspection. In August and September the engineer of structures and division engineers make a field check of the preliminary inspection. From this checked inspection both the maintenance and improvement material requirements and work programs are made for the following year. Annual material requirements are set up in detail, divided into quarters. This statement, when approved by the chief engineer, together with the work program, which indicates the quarter in which the more important improvement and repair projects are expected to be undertaken, is turned over to the general purchasing agent and general storekeeper, usually not later than mid-October. There are never any delays to the bridge and building forces on account of the slow delivery of material; it is always ready for delivery when ordered." On this road, the total disbursements of bridge and building materials in 1939 amounted to $972,500. The average stock was $234,410, or 24 per cent of the annual disbursements.

Funds that are tied up in materials held in storage in excess of an amount sufficient to meet requirements promptly, plus a reasonable surplus to meet emergencies that cannot be anticipated, is dead money, entirely out of circulation. On the other hand, any increased expenditures for labor as the result of not receiving materials when needed, is a wanton waste. Therefore, to eliminate as much of the dead money and wanton waste as possible, it becomes obligatory on the part of bridge and building departments to be consistent in the compilation of material requirements and to keep the stores departments fully advised as to dates for delivery, sufficiently in advance to permit the assembly of the materials. When this has been done, the responsibility for meeting the demand rests upon the stores department.

In 1930, the disbursements for bridge and building purposes on 19 roads, with a total of 88,000 miles of lines, were $12,500,000. The average stocks were $7,100,000, or 56.8 per cent of the disbursements. From 1930 to 1939, the average stocks decreased 28.9 per cent, while the annual disbursements decreased 26.2 per cent. In 1939 no complaints were made of

delays incidental to a shortage of materials by the roads reporting. If the 19 roads reporting are representative of all of the railways in the United States, average bridge and building stocks would amount to approximately $14,325,000, with annual disbursements of some $26,175,000.

It is obvious that if the bridge and building departments of the railways would adopt a plan of making conservative estimates of material requirements on an annual basis and then divide them into halves or quarters; also prepare work programs indicating the half or quarter of the year in which the larger improvement and repair jobs would be done, and furnish this information to the stores departments some time prior to the first of the year, thereby permitting a spread of purchases over a longer period, a considerable amount of the frozen funds invested in average stocks held in storage could be thawed out without creating any waste in bridge and building department work because of the delayed delivery of materials.

With reference to the delivery of materials by truck, using the highways, an assistant bridge engineer on a northeastern system advises that: "Trucks operated on the highways have proved efficient and economical for delivering bridge and building materials and repair parts for water and fuel stations. It is more economical to rent trucks commercially than to buy them if there is insufficient work to keep railroad trucks busy full time." A bridge engineer on a large northwestern system states: "In line with the general need for labor saving equipment, we could use more trucks."

These two pertinent comments on the use of trucks are, generally the consensus of 19 roads that favor their use. The opinions of five roads that do not favor the use of trucks is expressed in the following comment of a chief engineer of a large southwestern road: "The use of trucks for the transportation of bridge and building materials is not considered either efficient or economical by this road." His road, however, has not used trucks for this purpose.

Conclusions of the Committee

From the information furnished the committee by a majority of the stores departments heard from, it seems that the annual forecasts of material requirements furnished them by the maintenance departments are viewed with more or less suspicion and cannot be entirely depended upon to reflect actual requirements. Therefore, in purchasing the anticipated annual requirements, the stock book is reviewed for several previous years and an average of the annual stock, as shown, is used, rather than being guided by the forecasts as furnished. Frequently, the nature of the bridge and building work varies considerably from year to year. In one year, for example, a larger part of the program may consist of heavy repairs and replacements to steel bridges and culverts, and extensive renewals or replacements of certain types of buildings other than those constructed of lumber, requiring for that year a much smaller amount of material for pile and frame trestles and for the maintenance of wood buildings. In the next year, the program may be completely reversed. The average "stock book" method of acquiring the next year's material could, under circumstances such as these, result in a most serious excess stock of material in one year, and an embarrassing shortage in another. The stores department has the "average stock" for an alibi, while the maintenance department has the excuse

that its forecast of requirements was not given consideration.

Conservative annual forecasts, divided into six, four or three months, supplemented with a work program indicating in which period of the year the larger renewal and replacement projects are expected to be undertaken, should completely solve this problem by furnishing the stores department a much more accurate estimate of requirements than it is able to obtain by consulting the "stock book" for previous years. It seems rather extravagant to have materials ready for delivery in January that will not be used until July or later. On the other hand, it would not be economical to receive materials in July or later that should have been used in January.

Hardware, bolts, spikes, paints, etc., constitute a considerable part of the average stocks maintained and of the annual disbursements—perhaps as much as 25 per cent of the total. A structure cannot be completed without a full bill of hardware. Therefore, hardware becomes an item of as much importance as piling and lumber. Its shortage, no doubt, is the cause of more or less continuous controversy between the stores and maintenance departments. It frequently becomes a serious burden to train and station baggagemen. Most of the hardware required is of a standard type, easily and quickly procured. There should never be a shortage of it in the stores department, and not necessarily an excess stock. Hardware requirement controversies, at least in large measure, could be overcome by listing annual requirements; soliciting the cooperation of the stores department to bring its stock of each item up to 30, 40 or 50 per cent of the year's requirements, then asking it to keep a close check on the stock and to replenish each item promptly when it is depleted to 15, 20 or 25 per cent of the annual forecast.

Any habitual shortage or delay in the delivery of standard stock items of maintenance materials, either at general or outlying stores, could, no doubt, be overcome in large measure if the party who is being inconvenienced would handle the matter for correction through the proper channel with the general storekeeper. On the other hand, excess and slow-moving items at these points can, perhaps, be eliminated entirely by the annoyed party, if it will pursue a course along the proper route to finally reach the chief or maintenance engineer. Stocks of obsolete, off-standard materials and supplies that are not being requisitioned, could be disposed of readily if the stores department would send out a monthly or quarterly list of such materials to bridge and building supervisors, who, in turn, could look for places where these items could be used after obtaining proper authority, rather than allow them to deteriorate.

The delivery of materials by the stores department to the sites where they are to be used is a most important matter. It requires constant vigilance by this department, the maintenance department and the operating department. If requisitions indicate the date when the material should be delivered at a site, the stores department will be in a position to request cars for loading sufficiently in advance of the delivery date to insure cars being furnished. When cars are loaded and waybilled, the stores department can assist the maintenance department in being ready to unload the cars by giving it early notice of shipment. Likewise, the operating department can be of material assistance in the prompt unloading and release of cars by notifying the division bridge and building supervisor when cars will be at the

site. Supervisors, in turn, can render much assistance by notifying the operating department promptly when each car is unloaded.

The word "RUSH" on a requisition is anathema to most storekeepers —delivery dates, however, are a source of considerable satisfaction to them. Small lots of material requisitioned to be shipped to several points within the same general territory should, in so far as possible, be placed in one car, to be moved from station to station for unloading. When this is done, care should be used in loading to the end that the material may be unloaded in rotation without difficulty.

As pointed out earlier in this report, the maintenance departments on a few roads hold in storage and deliver bridge and building materials. The reason for this is because these roads are large users of creosoted piling and lumber and take into consideration the outstanding capabilities of their engineering personnel in the matters of timber inspection, seasoning, preframing and boring, treating, final delivery and use. However, those roads that leave these matters to the stores department, give this department the full advantage and co-operation of the members of their engineering department who are proficient in these practices. In the first instance, the purchasing and stores department co-operates with the engineering department. In the other, the engineering department co-operates with the purchasing and stores department. The ultimate results are, no doubt, the same.

In Retrospect

Prior to the enactment of the Interstate Commerce Act in 1887, the operation of the railroads in this country was extravagant. The roads were unrestricted. There were numerous departments and sub-departments. Each department was independent of all others. Each maintained its individual store and purchased its materials and supplies. With the gradual extension of Federal supervision over their finances and rates, drastic retrenchments had to be made. It was, in time, determined that departmental stores and purchases constituted one of the great extravagances of the system.

General View of the Burlington System Stores Layout at Aurora, Ill., Showing the Main Storehouse in the Background

In the years following the Commerce act, as a measure of economy, the numerous departmental stores and purchasing departments were set aside and replaced by a system stores department in charge of a general storekeeper. These general storekeepers were authorized to purchase, store and deliver materials and supplies for all departments of the road.

To this system, all other departments, naturally, were antagonistic. For some years their new officers, whose duty it was to make purchases advantageously and to see that materials were not wasted, were in a most difficult position. They survived mainly for the reason that from the beginning of their operations they were in a position to prove the economy and efficiency of their system. Under the old system, purchases were made at the discretion of the head of each department, perhaps regardless of price and quality, and frequently in vast quantities. The materials and supplies were stored at various places and were not accounted for in detail. In many instances, much of the material was not used and in time deteriorated into a total loss to the road. Under the new system, purchases are made by the purchasing agent on a competitive basis, quality and durability considered, in sufficient quantities to meet current requirements. The materials and supplies are stored by the general storekeeper and are so delivered that their disposition is accurately accounted for.

Conclusion

If the information furnished this committee by both the maintenance and stores departments of 24 different systems, constituting 50 per cent of the railway mileage of this country, is accurate, co-operation between the stores and the bridge and building departments has almost reached the apex of efficiency; apparently, to such an extent that it matters little to either department where the jurisdiction of the other ends. However, the recommendation of a chief engineer of a western system as to how to improve the service of the storage and delivery of bridge and building materials—"Make bridge and building men more dollar conscious" is indeed a most appropriate suggestion.

DISCUSSION

President Bechtelheimer: Thank you, Mr. Caudle. Your report should be studied carefully by the purchasing, stores and maintenance men of our railways. Such a study should be of great value to all persons whose duties bring them into contact with bridge and building materials. You have assembled information from both sides of the question and have found that all parties are working towards a common purpose and in most cases are succeeding well.

G. S. Crites (B. & O.): I wonder how much attention the committee gave to the proper order in the delivery of materials from the stores department to the point of use? In case of a pile trestle, for example, to prevent the deck, ties and stringers from being delivered before the piles.

President Bechtelheimer: You mean, instead of sending it all to the job before work begins, to send it out as it is to be used?

Mr. Crites: In order to get the material out of stock there may be a tendency to send it out as it is received or purchased, and thus, it may not come out to the work in the proper sequence.

President Bechtelheimer: Have you any answer to that, Mr. Caudle?

Chairman Caudle: There was no investigation made of that phase.

G. W. Rear (S. P.): It seems a little late for a report such as this to be studied by the purchasing, stores and maintenance departments, because I believe the report is largely a description of what the railroads have already been doing. This question has been studied for 15 or 20 years by those concerned. We know that a well-regulated railroad gets along better if its expenses one year are about the same as they were the previous year. Those railroads that are run on a fairly uniform basis get along best. On the Southern Pacific, we try to base each year's program on what we think we can get, and what we can do. There isn't any use having a program larger than the budget. Even if we can get the money, we don't ask for it if we cannot do the work with our regular forces. We inform our general storekeeper in the fall whether our program is going to be a little larger or a little smaller, and he is governed by his knowledge of what has been required from year to year. If we have a special job coming up that requires a type of material not generally carried, we advise him. For instance, on our road we use piling from 20 to 135 ft. long. Now, there may be years that no extremely long piling will be required; yet, we may see a job a year or two ahead where it is going to be required, so we notify him a long time in advance that that job is coming up. Extremely long piles are easy to get, and yet, hard to get. You cannot go into the woods and take out only 135-ft. piling. They must come out when other lengths are cut, so the purchaser must place an order somewhat in advance for anything longer than commercial sizes.

We do not treat any material except piles, until it is actually under order. We have instructions to put on all requisitions, the date on which the material will be required.

It is a great nuisance to have a half dozen cars of material scattered along the line before a bridge gang is handy to unload it. As a consequence, sometimes, if the material is sent out too far in advance, the track men will unload it in order to release the cars.

Now, if the B. and B. supervisor doesn't get the material he wants first, it is his own fault. We have introduced all of our B. and B. supervisors to the storekeeper and these men generally work pretty close together. They swear at each other enough so that supervisors generally get the material they want in the proper order and at the time it is needed.

To diverge a little: I have a pet "peeve," that I don't hesitate to express all over the road, and that is, the waste of material. There is hardly a bridge job that I visit that I don't find washers, nuts, spikes and bolts, being tramped into the dirt. I see it in track work, too, but that isn't our problem. We are putting up a continual fight, trying to make our men clean up these materials. The loss of such materials can be much worse in our part of the country where we have snow, because they get snowed under; then the weeds grow up in the summer. I think I could save my salary for the rest of my life gathering up scrap under bridges. I presume that all of you have the same trouble and maybe you are just as abusive about it as I am, but it is a sour subject with me.

We talk about co-operation.—Well, it can be accomplished only by having real bridge men on the one side and real storekeepers on the other.

Mr. Crites: It is very pleasing, indeed, to know that the Southern Pacific has solved the problem of getting materials on the ground in the proper sequence. The man who established the modern stores department on the Southern Pacific is now director of purchases on the C. & O. Maybe some C. & O. man will tell us how it works out on his road.

President Bechtelheimer: Mr. Church, can you do that?

H. M. Church (C. & O.): The Southern Pacific practice, of handling bridge and building materials, as outlined by Mr. Rear, corresponds very closely to our practice. Our co-ordination is so good that the stores department is practically looked upon as a part of the maintenance of way and construction departments.

In addition to the system storekeeper, we have a district storekeeper. While they coordinate the work between all of the different departments, we look upon the district storekeeper largely as one of our men.

The distribution of our bridge and building and track materials is by means of a supply train, and is very prompt. The supply train is operated frequently, over the east end of the road at intervals of two months and over the west end on another schedule. Therefore, supplies can be checked up and any surplus gathered up. Furthermore, it provides a cross-check and coordination between the supervisor and the storekeeper, the latter of whom travels with the train. In this way we maintain a very close check on our materials. All requisitions are scheduled. Requisitions that require assembly are marked. Different requisitions for the different classes of materials are marked to be assembled for shipment when they come direct from the store department.

I think it is a very satisfactory arrangement that we have on the C. & O. Our treated material comes from one plant and our untreated lumber comes from another location, but our orders for these materials are scheduled by close coordination between the district storekeeper and the division supervisor.

Mr. Crites: The assembly of materials by the stores department so that shipments can go out in the proper sequence is the answer to the question. I am wondering how fully the C. & O. follows the practice of assembling the material so that it comes to the job in the proper order?

Mr. Church: We program the work. We purchase our lumber from 12 to 16 months ahead of time and have a considerable quantity on hand. For a specific job, the material is assembled and shipped so that it will reach the job at the time the forces are available to do the work.

President Bechtelheimer: Mr. Batey, have you anything to add?

W. A. Batey (U. P.): Co-ordination begins on the division with the supervisor. After he has made his inspection the previous year, and the work is properly programmed, there is little reason for shipments moving out in the wrong order. So far as the Union Pacific is concerned, this problem has been pretty well ironed out. We have just one objective and that is to get the work done with the least possible expense. The only way this can be done is by co-opera-

tion. If co-operation is not given freely, it is only a question of time until one finds himself on vacation and another acting in his place who can and will co-operate. That is a little drastic perhaps, but, at the same time, it is good business. It is just as important to the stores department, or should be, that specific dates are set for certain things to be done, as it is to go to staff meetings on specific dates, and all efforts are directed toward that end, so that materials will arrive in proper sequence and at the time that they are needed.

J. S. Gabriel (D. & R. G. W.): I want to speak for the store department, being in that end of the work. I think that on all railroads there is increasing co-operation between the using and the supply departments. We all work towards one common end, and that is to have money left in the till. The money we spend, no matter who spends it, all comes out of the same pocket. By co-operation between the using and supply departments, we have been able to reduce the inventory investment on all roads. Material on hand is not nearly as good as cash on hand. You can use cash anywhere but there is only one place you can use material, and that is in the property when you need it.

I have seen a great deal accomplished through the use of standard materials, and by keeping the storekeeper advised of any changes in standards. The question was brought up yesterday about the storekeeper being supplied with a bill of standard materials. That saves a lot of time and allows the storekeeper to carry a good stock of such materials. Our aim is to stock material so as to be able to supply the using departments adequately, with the least possible investment; and we can't do that without co-operation.

We know pretty well today what we are going to need and to buy tomorrow. Thus, we can buy it out of season, treat it and have it ready.

The return of unused material to the stores department is a big item. If your job has been curtailed and you don't need all of the material sent to you, the storekeeper urges you not to try to pack it on your camp cars, but to load it up and send it back to the stores department.

As to getting the material you need on the job in the proper sequence, that should be a simple matter in any well organized store department. Certainly, piles should get there first, then posts, caps, ties and hardware. It is such proper practices that are reducing the railroad's investments in materials, and that are putting into other purposes money that formerly was wasted in carrying surplus material.

Some time ago Professor Cunningham, of Harvard University, together with a number of railroads, made a study of the cost of carrying material, counting interest on investment, depreciation, obsolescence, interest on storage facilities, cost of handling materials, etc., and arrived at the surprising figure of 18½ percent. Of course, lumber properly treated doesn't deteriorate so fast. Sometimes there is obsolescence and considerable deterioration in raw materials. When we cut down our stock a million dollars, we don't necessarily have that amount of money to work with, but we save the interest on that million dollars.

Mr. Rear: The remark was made, earlier in the report or in the discussion that obsolete material is a great loss. If that is true, it is our fault, not the fault of the stores department. We use only one size of stringers, caps and bracing; only one size of everything for standard structures. When the standards are changed, there are branch lines and other places where all old material can be used up, because it doesn't make much difference whether the new standard goes into effect at these points today or six weeks from today. The maintenance department should see that everything is used before the new standard is started, or that it is used on less important lines.

Here is another grand scheme; walk through the store yard and look for material that some other fellow has shipped in that you can get for practically nothing, and use it. You can always find a place to use material that doesn't cost much.

Another thing, we try to make all repairs out of second-hand material. We have a peculiar climate. In our country, untreated stringers will last from 20 to 25 years, but maybe the trestle is worn out. However, you can get a lot of good material out of it with which to make repairs. That condition doesn't exist in all of our territory, but it does over quite a lot of it. When we have to repair a lot of stringers, we put a new deck on one group of trestles and take the second-hand ones to repair those adjacent. I have found that a new stringer put into and old trestle is just a nuisance, and will probably break very quickly, because it is so much stiffer. Repairs to an old trestle are best made with stringers of the same general age as those in the trestle.

Elmer T. Howson: (Ry. Eng. & Mtce.): I was on an inspection trip over a railway last week in which the question of the use of second-hand material came up. The general manager and chief engineer were in the party, together with some of the local officers. They were discussing the results that had come from changing the basis for charging out second-hand material. Their stores department had been charging it out at a price approaching new material, and it was not moving because the division men looked at the charge for the available second-hand material and figured it just wasn't a good buy. The difference was so small that they insisted upon receiving new material. So they tried the experiment of offering second-hand material to their local people without charge. And that is working out very fine. They are finding they can use second-hand material, can avoid the purchase of new material, and that they are not being penalized by high charges for using that second-hand material. It is a practice that is cleaning up a lot of second-hand material. They are getting better results than they would have gotten by charging out second-hand material at a higher price.

Mr. Crites: When I opened the discussion I didn't want to throw any monkey-wrenches into it, but I thought we might get something on the use of second-hand material. We have a great many bridges on lines that we are abandoning for various reasons, and the second-hand material can be used very nicely. Of course, if some statistician sets up the cost of labor

against the cost of material, and you have no charge for material, it doesn't look very good for the B. & B. supervisor, and might reflect on him higher up. So, on our road, we set a price of $10 for second-hand material.

We find too, there are locations where we can get second-hand material out of buildings, such as siding, which will fit in with the same materials in that general territory.

Another thought: On many roads, both the maintenance of way, bridge and stores departments are doing a 100 per cent job in using available good material, but if this is true, the C. & O. is doing a 150 per cent job. I still would like to have some C. & O. man, other than Mr. Church, tell us about their practices.

W. A. Hutcheson: I think I appreciate Mr. Crites' first statement in regard to the delivery of material in the proper order. We have experienced something of what he mentioned in the past. However, in the last few years, the co-operation between maintenance men and the stores department has done a great deal to clear that up.

We have a district storekeeper whose headquarters are on the general division, but it is his duty to go around from time to time, which is usually rather frequent, and contact maintenance men relative to their general requirements. If we have a special problem that we would like to discuss, personally, it gives us a first-hand opportunity to do this with the stores department to see if it can be worked out to the best advantage of that department and of the men who are to apply the materials. I think it is largely a matter of programming materials. Some railroads experience difficulty in carrying out well organized programs when they are confronted with an emergency, such as a flood, which disrupts the programs. In such cases, I think it is strictly up to the maintenance men to give the store department the full benefit of what changes will be made in the regular program so that the requisition dates, that is, the delivery dates, may be adjusted accordingly; and I feel that on our railroad in particular, if there has been any failure along this line, it has devolved strictly upon the maintenance men and not upon the store department, because they have no way of determining just what our requirements are unless we advise them.

W. A. Sweet (A. T. & S. F.): I would like to ask Mr. Crites; in that storehouse price of $10 for second-hand material, that you mentioned, do you make any distinction as between treated and untreated material?

Mr. Crites: Most of the old material we recover is untreated. When we send in stringers that will be usable for bulkheads or blocking, we take them into our stock at $10; then the cost of treatment is added to it. That is, when the treating plant sends them out, it adds the handling charges and treating cost to that particular material. But, generally, for building work, the wood is untreated and we use it where untreated wood is suitable.

W. A. Hutcheson: I might supplement what has been said in regard to the practice on our railroad of notifying the stores department with regard to delivery dates on material, to say that while the program is forecast a year in advance, local conditions or changes in plans sometimes disrupt the pro-

gram. Therefore, each supervisor makes up a semi-monthly report covering his expected requirements for the next 30 days. That report is furnished to the stores department and to the division office as well, which gives the stores department a closer check on delivery dates than the annual program provides.

President Bechtelheimer: That is very good.

F. H. Soothill (I. C.): On the Illinois Central, rather than tear down old buildings for second-hand material, we have our division people secure an outside price for the demolition of a building. And we find in most cases that we can save money by having these buildings moved right off the property. The buyer takes the salvage and, as a result, we are not burdened with this second-hand material; we get more money out of it that way than by trying to salvage the material ourselves.

President Bechtelheimer: That is probably true of most buildings.

Mr. Crites: That is largely true generally; you can usually get a local sale. But at the same time, you wouldn't want to purchase new material for a place where you could readily salvage the material out of an old building and use it for repairs. We, also, sell a great many buildings, but we save enough to try and keep ourselves supplied with second-hand material for necessary building repairs.

Mr. Church: I might add that on our road second-hand material, in many respects, is at a premium. We need it. We program our work, such as trestle renewals, out-of-face, very similar to the way Mr. Rear has mentioned, and we have such a large demand for his material in connection with construction work — for blocking, falsework etc., that it is exceedingly valuable to us, at the usual price charged of about $10.

H. O. Wray (Tex. City): It is getting close to the end of the discussion and I would like to leave a little case of perfect co-ordination in the minds of you men. I happen to be in the engineering department, the bridge and building department and the maintenance department, and am supervisor of storekeepers. If you can beat that for co-ordination, I would like to hear about it.

Mr. Rear: He is the fellow we have been looking for for a long time.

Mr. Crites: Since I started this discussion, I might add this further thought about the stores department and the B. & B. department. One must realize that there are very few mind readers in either department—that one has to inform the other of the functions that they are to perform, and that they must work together.

A. M. Knowles (Erie): From time to time our stores department publishes a list of those materials which do not move rapidly through the stores. For instance, if they have some second-hand material that does not move, whether it be timber, iron channels, angles, or anything that is usable, they send a list to the department of structures and to the maintenance department to see if they have any use for the materials. That gives us an opportunity to select some very good material, sometimes at a very nominal price. They make

the price very low—practically scrap price—and in that way the material is disposed of.

Mr. Crites: There is one other thought. Both the stores department and the maintenance of way department can, if they will cooperate with the unclaimed freight department, save their railroad considerable money.

President Bechtelheimer: We will have to stop, although I believe we could go on constructively for another hour. The committee is discharged, with the thanks of the association.

Bridges on the Shasta Line Diversion of the Southern Pacific

By George W. Rear

Engineer of Bridges
Southern Pacific, Pacific Lines

(Introduced by President Bechtelheimer)

Geo. W. Rear

President Bechtelheimer: We will begin the program of the evening and I will introduce George Rear, bridge engineer of the Southern Pacific, Pacific lines.

Mr. Rear has been with the Southern Pacific since 1902, starting as a foreman in steel bridge erection, then bridge inspector, and, since 1922, bridge engineer. He has been a member of this association for 36 years and was its president in 1915-16. He has been a tireless worker for this association and an inspiration to all those members who know him.

Mr. Rear will tell us tonight the story of the Central Valley project of the federal government in the upper Sacramento River valley in northern California, and, more particularly, of the 30-mile line change called for on his line, involving the construction of eight major bridges, some of which involve outstanding features of design and construction. Mr. Rear, representing the chief engineer of the Southern Pacific, has been in intimate contact with all bridge designs, and with erection in the field.

We are proud that one of our members is associated with such important work, and are, indeed, fortunate that he has consented to tell us about it.

Address by Mr. Rear

The Central Valley project in California, which has brought about a 30-mile line change on a section of the Southern Pacific's main line between San Francisco, Cal., and Portland, Ore., is by no means new, as it has been under consideration by the Bureau of Reclamation for 38 years. It is not the purpose of this project to develop new and untried areas, but to furnish a dependable supply of water to lands that have been cultivated for 75 to 80 years, and to

prevent a large amount of recurring damage to property due to flood waters. It will also prevent many thousands of acres from becoming barren due to salt water saturation.

The long low-water periods of the Sacramento river, with the shortages accentuated by taking much that remains for irrigation, allow the salt water of San Francisco bay to back up the river nearly to Sacramento, filling all of the drainage canals, and at times covering the cultivated lands, ruining them for cultivation. For many years there have been projects for building dams to prevent this encroachment of salt water up the river basin. In 1920, salt water worked its way far enough to have marine borers destroy all untreated timber for more than a hundred miles from the bay, at a loss of probably 30 or 40 million dollars. The present project will prevent such damage.

While nature has been kind to California, bestowing on that delightful land an abundance of sunshine, productive lands and bountiful rainfall, it apparently has left to the engineer the problem of coordinating these bounties as to make them serve the 20th century population. There is an abundant rainfall in the winer, flooding the rivers and damaging much valuable property, followed by long, hot dry summers with little or no rainfall. During the last winter, 639,000 acres of land were covered by flood waters and the flood damage amounted to many millions. Fortunately, extreme floods occur only about once in 10 years.

The task of the engineer is to hold the water in storage during the rainy periods, releasing it when required. The topography of the state is well suited for such a project and the cost will be abundantly repaid from the benefit derived.

Involves Large Dam

As you probably know, California extends north and south about 1,000 miles, and east and west about 200 miles. In the central portion, with San Francisco at about its center, there is a coast range of mountains skirting the coast, and a higher range skirting the eastern border, known as the Sierra Nevada. Between these ranges lie the Sacramento and San Joaquin valleys—almost level areas embracing approximately 2,000,000 acres of fertile lands capable of growing several crops a year if watered sufficiently.

As provided by nature, these valleys were perfectly satisfactory for the indians and wild animals of the early days, and were not entirely unsuited for the great cattle and wheat growing ranches of the early white man's time, but for intensified farming, growing crops not readily grown elsewhere, water is needed at a time when nature is unwilling to supply it. All available water is now used, the greater quantity being obtained by pumping from wells. In a series of dry years, the water table drops until it becomes a question of whether the water supply will fail completely.

It has required the brains of many engineers and a great nation's resources to bring about a means of overcoming this. It is a big job and will cost close to $200,000,000, but it will give future security and productivity to 2,000,000 acres of land.

The first construction requirement of such a prospect is a dam. Fortunately, a splendid site, situ-

ated in the proper place, was available for a dam, and there is now under construction a structure 560 ft. high, with a base 580 ft. thick. The excavation for the dam amounted to about 3,800,000 cu. yd. The concrete required will be about 5,600,000 cu. yd., which it is planned to place at the rate of 6,000 cu. yd. a day. The storage behind the dam will be about 4,500,000 acre feet.

The construction of this dam takes advantage of all of the improvements in methods and machinery in dam construction in the past and involves an extremely efficient plant. The excavation work for the dam is now completed and work is under way placing concrete as rapidly as limitations will permit.

The Southern Pacific Shasta route occupies the river canyon throughout the Sacramento arm of the reservoir that will be impounded by the dam, and as the railroad will not be out of the canyon before the next rainy season, only 1,300,000 cu. yd. of concrete can be placed in the dam without the liability of flooding the railroad. As soon as the next rainy season is passed (about April 1, 1941), the placing of concrete can proceed at full speed.

The concrete aggregate for the dam is transported from the gravel pits to the storage pile near the dam by a belt conveyor 9½ miles long, the longest ever built. This belt has a maximum capacity of 22,000 tons a day. The cement is transported in bulk railroad cars to the vicinity of the dam, where it is unloaded in silos. It is then blended and blown through a pipe line to the mixing plant.

The dam will raise the water level about 500 ft., so it became necessary to relocate and rebuild the Southern Pacific tracks at a higher level. The relocated line is through rough and mountainous territory, and much preliminary surveying was required to secure satisfactory alignment and grades. In fact, the line is almost a continuous series of tunnels and bridges, passing through a spur of the mountain, then across a canyon, and then through another spur to come out on another bridge.

Requires 30 Miles of Heavy Line Construction

The old line followed the Sacramento river throughout its canyon and was of reasonably easy construction, but the new line had to be laid out over deep side canyons and through or around mountain spurs, with the result that on the 30 miles of new railroad there are 8 major bridges and 12 tunnels, the bridges aggregating 12,202 ft. in length and the tunnels 19,010 ft. In other wors, of the 30 miles of railroad, bridges and tunnels occupy six miles. In fact, the six miles of bridges and tunnels are located on 15 miles of the new line.

Many of the fills are more than 100 ft. high, and one cut is about 200 ft. deep. The principles of soil mechanics have been applied in making the fills and they are compacted to such an extent that surveyors are unable to drive stakes in the roadbed. Therefore, it is the practice to mark the center line with nails.

Soil mechanics, if you do not all understand the term, involves the scientific classifying of the fill materials so they can be compacted. Materials from different parts of the cuts are blended in the fills,

which are built up in layers six inches thick and carefully compacted before the next layer is put on. So effective is this method of construction that it is expected that fills up to 100 ft. high will not settle more than an inch during any future time. It formerly was customary for fills anywhere near that high to settle 15 ft. before they became stable, but these fills will not settle more than an inch, or two at the most, in a 100-ft. depth.

The cost of the railroad reconstruction is being borne by the United States Bureau of Reclamation and the Bureau has complete charge over the design and construction, in accordance with specifications agreed upon. The line is being constructed to Southern Pacific standards in every detail, and the Southern Pacific checks the plans and maintains a general check of the construction work as it proceeds.

The new railroad diverges from the present line in the town of Redding, Cal., and immediately turns to the east on a four-degree curve. On this curve it crosses the Sacramento river and its bottom lands on a viaduct and deck truss bridge which has a total length of 4,347 ft. The trusses over the river are 169 ft. long and the viaduct each side has 35-ft. tower girders with intermediate girders 60 to 100 ft. long. The height over the river is 103 ft., and the rate of grade is 0.8 per cent.

The footings of the river piers and those adjacent rest on shale rock of great depth. All of the piers were built before any of the steel erection began, and in general, the viaduct towers were hauled in by trucks and were erected by crawler-mounted cranes from the ground. The longer girders and the truss spans were erected by a locomotive crane from the bridge deck.

Falsework for the erection of the truss spans consisted of steel H-beams driven as piles, above which other steel bents were placed. The steel beams used for piles had

Erecting the Bridge Over O'Brien Creek, Showing the 50-Ton Guy Derrick Raising One of the 100-Ft. Girders for Span No. 2.

The Completed Second Crossing of the Sacramento River. Note Steps in Piers, Intended to Permit Second Track Construction at a Later Date Without Lowering Reservoir Level

punched holes along two sides at close spacing, which permitted attaching caps at any height desired.

Pit Bridge Most Spectacular

Beyond the first crossing of the Sacramento at Redding, the railroad proceeds through a rather open country until it reaches the vicinity of the Pit River Canyon, where it passes through two tunnels, one 2,765 ft. long and the other 2,684 ft. long—with only about 1,000 ft. between them. Emerging from the second tunnel, it comes out on the south side of the Pit river canyon where the most spectacular bridge on the line is now under construction. This bridge, a double-deck structure, is 3,468 ft. long and 488 ft. above low water in the Pit river. It is for a double-track railroad with a four-lane highway above. Two of the piers, both located on the sides of the canyon, are 384 ft. in height.

At present, concrete is being poured on every pier in the bridge; several of them being completed. The main span across the canyon is 630 ft. long, which is flanked on each end by an anchor span 497 ft. long. The remainder of the bridge proper on each end is filled out by truss spans, in general, 282 ft. long, with a shorter truss at each end. The structure will involve the use of 96,000 cu. yd. of concrete and 18,000 tons of steel.

O'Brien Creek Bridge

After passing this bridge, we follow through a very rough country and, after passing through Tunnels 3, 4, 5, 6 and 7, come to O'Brien creek. The bridge here has two 200-ft. deck trusses and six 100-ft. deck girder spans. It involved the use of 13,000 cu. yd. of concrete and 1,425 tons of steel. The spans and all other steel for this bridge were brought in on trucks, there being no railroad at the time within about five miles. The big girders were first set in position under the bridge, and were then picked up and set in place on the piers with a derrick. This method of erecting steel bridges is one of the newer

Erecting One of the Truss Spans of the Second Crossing of the Sacramento River. Note the Safety Net and the Needle Beam at the Foot of the Erecting Derrick Mast.

methods, and is useful where the tracks have not been laid up to the bridge head at the time erection is undertaken.

A needle beam, about 90 ft. long, placed crosswise of the bridge, was used to take the side guys from the top of the derrick mast. The back guy was run well back, and the forward guy was usually run over to the next abutment. The needle beam was lashed down, generally to the bottom of the pier. In the construction of the piers, large U-bolts were cast in the concrete near the bottom to permit fastening the guys from the derrick.

Parts of the bridge were used for the one falsework bent used in erecting each truss span of the O'Brien bridge. In each case the bottom chords were trussed in order to hold them up to camber long enough to make the connection. After the span was connected, the bent was taken out.

In handling the long girders for this bridge, the derrick boom was first turned toward the rear and the girder was picked up. Then the boom was raised until it practically touched the mast. Following this, the derrick mast and boom were turned around and the boom lowered, lowering the girder out to reach the next pier. This reversal of the derrick was made only while the boom was close to the mast and the girder was thus passed between the mast and the side guy.

Salt Creek Bridge

As soon as O'Brien Creek bridge is crossed, the line passes through Tunnel 8, which is 915 ft. long, and then Tunnel 9, close by, which is 1,610 ft. long. It then comes out on Salt Creek canyon, where the bridge being built will have four 175-ft. deck trusses, three 100-ft. deck plate girders, and four 90-ft. deck plate girders.

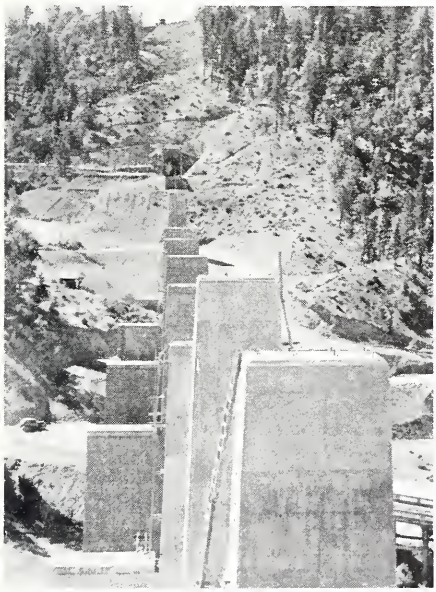
The substructure for this bridge has been completed for some time, but the plan for its erection contemplates the use of derrick cars, so the erection cannot take place until the track is laid up to one end. The steps shown in the piers have a very definite purpose. There is a probability that this line may be double-tracked at some time in the future, and as the reservoir will be full of water, it would be worth millions of dollars in water losses to have to lower the water to permit enlarging the piers from new foundations. Therefore, all of the piers that will be submerged at the ordinary summer level of the reservoir have been built large

enough to carry two tracks, to a point high enough that they can be extended up for the second track without going too deep under the water—making it unnecessary to empty the reservoir.

Other Bridges

In a short distance after passing the Salt Creek bridge, the line passes through Tunnel 10, which is 2,235 ft. long, beyond which it comes out on the Sacramento river again, which is crossed by a bridge 1,040 ft. long and 206 ft. high.

This is the Second crossing of the Sacramento, and is the first time we cross back over the river after having left it at Redding. The trusses of this bridge are 200 ft. long, and steps are provided in the piers to permit the subsequent construction of second track.



The Piers of the Salt Creek Bridge. Note the Steps in Their Construction, to Permit Enlargement for Double Track Later, if Necessary, Without Drawing Down the Reservoir.

Showing the Method of Erection Employed on the Third Crossing of the Sacramento River. Note H-Beam Falsework.

Beyond this bridge, the line follows more or less open country. We have gotten up on what you might call the summit of the range, and we now follow along about the level of the reservoir, to Doney creek, where the line crosses on a bridge that is 600 ft. long and 160 ft. high. This bridge consists of three 200-ft. continuous truss spans. After these spans were erected, it was necessary to weigh the reaction on the piers and then to shim up the spans to the proper height. This was an interesting job, made necessary to insure that the stresses in the different members would be as calculated.

After the Doney Creek crossing, the line crosses the Sacramento River twice before connecting up with the old line at Delta, Cal. The first of these bridges is 758 ft. long and 100 ft. high, and consists of

The Fourth Crossing of the Sacramento, at the North End of the New Line, Consists of Three 100-Ft. Simple Deck Plate Girder Spans.

one 200-ft. simple deck truss span and six 90-ft. simple deck plate girder spans. The second of the bridges is 308 ft. long and 67 ft. high, and consists of three 100-ft. simple deck plate girder spans.

The magnitude of the bridges on this line change will be noted from the fact that their construction required the placing of 175,500 cu. yd. of concrete and 30,270 tons of steel. The cost of the bridges will be between eight and nine million dollars.

Decks Treated

On all bridges on curves, the ties are bevelled on the top side to take care of the superelevation. Spacer blocks are placed between the ties to prevent their bunching or slewing. Alternate ties are fastened by hook bolts which extend up through the guard timbers, the intermediate ties being fastened with lag screws.

On our bridges we use a gage plate under the tie plate. Through this we secure a much longer life from ties due to lack of mechanical wear. We consider it poor practice to treat our ties to add to their life and then wear them out before that life is obtained. All bridges have sidewalks and hand rails, the type of hand rail being of our own design.

For these bridges, and all other Southern Pacific bridges, chromated-zinc-chloride treatment is given to all ties, sidewalks and other timber of the decks. This is to help prevent fires during our long dry spells. We feel that this treatment will prevent ignition of the wood by the usual causes, such as burning tobacco or other burning articles dropped from trains and by hot brake shoe slivers. The latter are probably new to most of you, but railroads with long, heavy down grades have slivers torn from brake shoes, some of which are red hot and weigh a half pound or more. Under favorable conditions, these readily set fire to track or bridge ties.

Another cause of fires is lighted fusees dropped from trains, but, in general, we can prevent this prac-

tice. It does not appear practical to prevent fires starting from certain other causes, but the zinc-treated ties will not maintain fire in the ties themselves.

Much attention has been given to the painting of the bridges on the new line, all of which are painted to Southern Pacific standards. I quote from our specifications in this regard.

"After the shop work has been completed and accepted, the surfaces of all structural members and the unfinished surfaces of all castings should be thoroughly cleaned of all rust, loose mill scale, dirt, oil, grease and other foreign substances, by the use of metal brushes, scrapers, chisels or hammers, or by sandblasting or other effective means satisfactory to the contracting officer. Oil and grease shall be removed by the use of petroleum naphtha.

"After being cleaned, all such surfaces, except surfaces to be in contact with concrete or in field-riveted joints, shall be given a priming coat of paint. Surfaces to be in contact with concrete shall not be painted, but shall be cleaned thoroughly immediately before the concrete is placed. Surfaces to be in contact in field-riveted joints shall be coated with lacquer or other coating material satisfactory to the contracting officer, which will protect the surfaces from rust until the joints are made, but which will not form a thick film. Surfaces to be riveted in contact shall be cleaned thoroughly before the parts are assembled. Surfaces not to be in contact, but which will be inaccessible after the parts are assembled, shall be painted before the parts are assembled."

The following formulas in our specifications do not agree with some previous reports of the Association, and probably not with some of our present reports, but they are our ideas of good work.

"The paint is to be composed of dry red lead, 33 lb., forming 79.23 per cent of the volume (in other words, the pigment is practically 80 per cent and the vehicle only 20 per cent); raw linseed oil, 1 gal.; turpentine, ½ pt.; and drier, ½ pt.—this total making 1.58 gal., which weighs 41.65 lb., the weight per gallon being 26.4 lb.

"The paint shall not be applied when the temperature of the air is below 50 deg. F. No paint shall be applied on damp or frosted surfaces, and materials painted under cover in damp or cold weather shall remain under cover until the paint is dry. The painting shall be performed in a neat workmanlike manner, and round or oval brushes shall be used. On surfaces which are inaccessible to brushes, the paint shall be applied with sheepskin daubers.

"After the erection of the steel superstructure is completed to the satisfaction of the contracting officer, all exposed unfinished metal surfaces shall be painted by the contractor, except that the surfaces of structural steel upon or against which the concrete of the highway floor is to be placed shall not be painted.

"Care shall be taken in unloading, hauling, handling and erecting the metal parts to preserve the shop coat in the best practicable condition. After erection, and immediately before being painted, all exposed metal surfaces to be painted shall be cleaned thoroughly and all damaged areas in the original paint film and the heads of

all field rivets shall be painted with a priming coat of paint. After the paint on the repaired areas and rivet heads has set thoroughly, two additional coats of paint shall be applied on the exposed surfaces as herein provided, or as directed by the contracting officer. All paint, except aluminum paint for the metal handrails and for the manhole frames and covers, shall be furnished in accordance with the following formulas:

"The first field coat is to be made of dry red lead, 26.8 lb.; lampblack, 0.23 lb.; linseed oil and turpentine; the pigment being 75 per cent and the vehicle 25.

"The final field coat is to be a graphite coat and the pigment is to be 40 per cent and the vehicle 60 per cent."

The paint materials are furnished to the contractor and are manufactured to Bureau of Reclamation specifications.

"All painting shall be performed in a careful and workmanlike manner satisfactory to the contracting officer, and each coat of paint shall be allowed to dry properly and shall be free from dust, dirt and other foreign substances before the succeeding coat is applied."

Now note the following clause in particular.

"To secure the maximum thickness of paint film on rivet heads and on the edges of plates, angles and other rolled shapes, these parts shall be painted with an extra coat in advance of the general application of each coat. Small cracks and cavities which have not been sealed in a watertight manner by the first field coat shall be filled with red lead paste before the second field coat is applied."

You will note that previous to putting on the first field coat the painter goes over and paints the edges of all angles, plates and lacing bars, and all rivet heads. This does not mean only field rivet heads, but all rivet heads in the bridge. Then he gives the entire structure the first field coat. He then goes over it again and paints all of the edges and rivet heads with the paint specified for final field coat.

This specification for painting applies to all of the bridges that are being built on the Shasta line diversion, and covers the general practice of the Southern Pacific in the painting of all new bridges.

[Mr. Rear's paper was accompanied by slides and a motion picture of the line diversion work.]

Streamlining the Smaller Passenger Stations

By Otto Kuhler

Consulting Designer, New York

(Introduced by Elmer T. Howson)

Otto Kuhler

Mr. Howson: Probably the most outstanding development in railway service in the last decade has been the revolution that has taken place in passenger transportation. Dozens of trains are now running at speeds that were thought entirely impractical as recent as ten years ago. Trains are now running, of designs that were unthought of ten years ago. These trains have captured the public fancy as nothing else in recent years has done, and have tended to bring the railways back into public favor in a very pronounced way.

There are today approximately 100 light-weight, streamlined trains in operation in this country, in both short-run local service and in transcontinental service. They are a new type of train—a type that so appeals to the public that even two and three years after they have been placed in service people still drive out to see them pass. There is an attraction about them. It is interesting to attempt to analyze the reason for this attraction, but that is largely beside the point. The fact is that they do attract and that passenger travel is coming back to the rails where these trains are in operation.

To board these trains passengers pass through stations, and as they board these trains—and more especially, as they step from the trains and pass through these stations—they feel all too frequently that there is a lack of harmony there. Beautiful, modern, up-to-date trains; not so modern, not so beautiful stations. Out of that feeling of inconsistency there is gradually emerging a consciousness that we must do something about these stations.

The new trains are not merely structurally efficient; they are good to look at. The fundamental design of these trains was in the hands of the car builders to insure that they had the strength, to insure that they would function properly and safely in the services for which they were designed. Then, very generally, the plans have been turned over to men who have added the touches here and there that have meant so much from the standpoint of attractiveness and pleasing effects, without detracting in any way from their efficiency.

The man who is to speak to us in

the next few moments has had a great deal to do in pioneering the streamlining of these trains. Starting with some of the very earliest of these trains on the Baltimore & Ohio, he has been called by one railway after another to look at their plans; to add those touches in the way of lines, illumination, color and other features that make for pleasing, harmonious, attractive appearance, and that have done so much to popularize them.

Recently, as the feeling has developed in certain quarters that we should give similar attention to stations, this man has been called in to consult on streamlining (as we call it) them. That work is in its very infancy. It is confined as yet to possibly not more than a half dozen railways, and on those roads it is confined to a few buildings. Yet the results in efficiency, in improved usefulness, and in general attractiveness, have been so pronounced that I am sure it is going to spread.

Not so long ago, I passed one of the stations that had been given this treatment. I had heard something of it, but I had not been in it. As I approached the station, the policeman on the street corner stopped me and said, "Wouldn't you like to see our station?"

I replied, "What interest do you have in this station?"

He answered, "We are proud of it." He was one of the policemen in that city. He then showed me through that station and told me in layman's language what had been done. I remember especially his statement about the modern illumination installed. He said: "You know, it costs only a quarter as much for the power now as it did with the old lighting."

I don't know where he got this information, but I think it was accurate. As a policeman who was proud of his town, he wanted a stranger to come in and see his station. Isn't that the sentiment we would like to create for all our railway stations?

The man who co-operated with the railway in modernizing that station, and who is today working with the engineering department of that same railway in modernizing some of its other stations, is to be our next speaker: Otto Kuhler, of New York City.

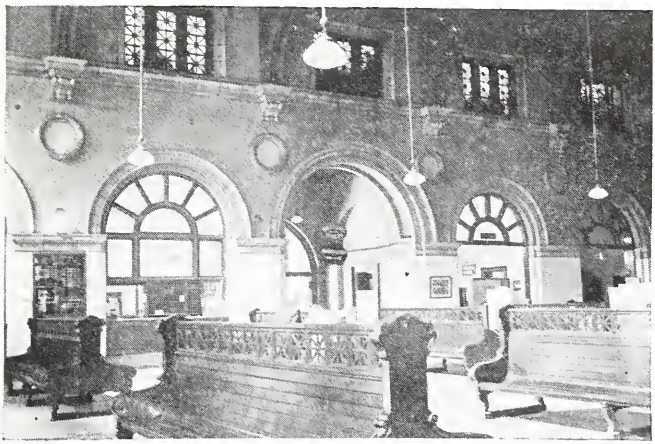
Address by Otto Kuhler

About two years ago, the operating vice-president of a large railroad received a telegram from the Chamber of Commerce of a medium-size town along the main line, reading: "You have given us excellent service, luxury, speed and comfort with your new streamlined trains. In contrast, your old passenger depot seems older than ever and is a disgrace to the community. We suggest that you modernize it for the sake of good will towards your railroad and greater comfort for our citizens that use it."

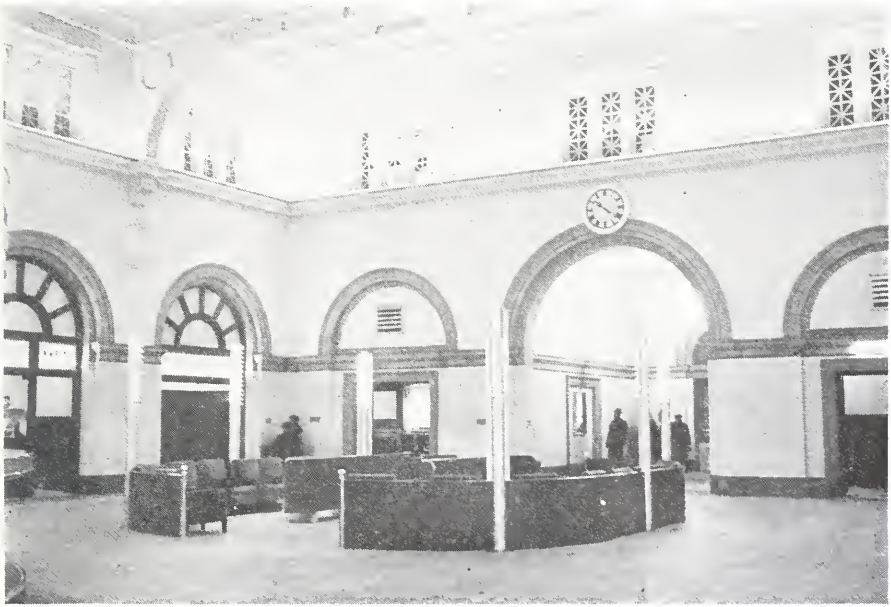
On an inspection tour somewhat later, this same vice-president, now conscious of the appearance of his passenger depots, felt that many of them could be improved and asked me to look into the matter. As you may know, I pioneered in the thought of streamlining locomo-

tives and rolling stock for greater passenger appeal, and, as you may know also, this has brought a large amount of traffic back to the railroads which otherwise would have been lost forever. When streamlining a passenger car, it is not a matter alone of better engineering, weight saving and general technical improvement, to be executed by the engineering staff, but also a matter of dramatizing these engineering improvements with lines, light and color.

I know from my experience in dealing with many railroads in this



No. 1 and 2—Before - and - After Photographs of the Waiting Room in the Milwaukee's Passenger Station at Minneapolis, Minn., Showing What Modern Furniture, Lighting and Paint Accomplish



country that they have capable engineering staffs and architects, and that these men are entirely capable of handling all engineering and architectural questions that may arise. However, the modern tendency of streamlining to merchandise, advertise and dramatize the appeals of the railways, has presented new problems concerning which many of these men might well have assistance.

Most of the work handled in railroad engineering offices is, naturally, along purely functional lines. Quite naturally, the aesthetic side is of secondary importance in the design of a roundhouse, freight house, or other such facility. When we come to passenger stations, however, the aesthetics of the interior and exterior become of very definite importance, as in this case we are making a direct personal appeal to the traveling public, and often also to community pride. Just as in the case of the many streamlined trains on which I have collaborated with mechanical engineers to incorporate greater passenger appeal, so I have been called in to assist the construction engineer and architect to incorporate into station designs the functional advantages and increased passenger appeal that comes with streamlining.

Our competitors, the bus and air lines, have taken great pains to locate their stations strategically and to make them as attractive as possible, both outside and inside. However, since almost every town grew up around the railroad station, we still have, in most cases, the most strategic position. We usually have well constructed and maintained buildings, but true also, they are usually very much out of style.

Don't misunderstand me. It is not my thought that every old railroad station should be torn down. Likewise, in most cases, it is not a question of improving the station by dragging modern methods and materials into the building, but rather, largely one of throwing out old junk.

New Material Aids

In the streamlining of a passenger station we must present the same drastic and dramatic eye appeal to our passengers that we have used successfully in our streamlined trains. I have heard such criticism as "the design looks like a gasoline station, a movie, a World's Fair building." To such criticism my answer must be, "That's fine, because each of the buildings referred to was designed in modern style, with modern materials, and for one reason only—to attract customers. There can be no argument against the fact that all of them attract customers."

In my modern designs, I have used modern materials. I have done this conscientiously because I refuse to fake. I refuse to make wood look like steel, or steel like wood. We have learned today that we can reduce maintenance and heat losses with glass brick, even in such places as roundhouses. Instead of something to stick in a hole for transparency, glass has become a structural material. Likewise, stainless steel, aluminum, chromium—all of these, formerly raw materials—have been made into decorative elements that simultaneously reduce maintenance costs. Rubber, asphaltum and asbestos, in their countless color combinations, permit us colorful interior and exterior appearances; permanent and inexpensive to apply and to main-

No. 3—The Waiting Room of the Rock Island's Station at Des Moines, Ia., As it Existed Until Recently

No. 4—The Same Waiting Room As it Will Appear When Modernization Work, Now Under Way, Is Completed

tain. Modern lighting has endless possibilities, both functional and decorative.

Examples Cited

As a typical example of what can be done with an old passenger station, I present contrast pictures of the station of the Chicago, Milwaukee, St. Paul & Pacific at Minneapolis, Minn., which was reconditioned recently under my direction, in co-operation with W. H. Penfield and A. O. Lagerstrom, chief engineer and architect, respectively, of that road. In this case, it was purely a matter of rearranging the existing facilities; of throwing out a lot of benches and replacing them with upholstered chairs; of painting the interior; and of lighting the interior with fluorescent light.

Illustrations No. 1 and 2 are before-and-after pictures of the waiting room at Minneapolis. In the old waiting room uncomfortable benches were arranged in a barricade fashion across the main traffic lanes; a newsstand and fountain spread far out into the public area; and the interior was gloomy and dingy due to improper lighting. The remodeled waiting room has a clean, sanitary newsstand and fountain set back out of the traffic

lane and properly recessed; upholstered seats arranged along, instead of across the main traffic lane; well-lighted walls and ceiling; and ornamental fluorescent lighting.

What correct lighting and the use of furred plywood can do for an interior is shown in Illustrations No. 3 and 4, which show the waiting room of the Rock Island station at Des Moines, Ia., as it has existed until recently, and as it will appear when modernized. This work was developed with the co-operation of W. H. Hillis, assistant chief operating officer, and David Ruhl, engineer of buildings, and is now under way.

When I traveled as a young engineer in Europe and looked for a boarding house I invariably asked

No. 5—The Men's Toilet Room at the Milwaukee's Passenger Station at Milwaukee, Wis., Before Renovation Recently

No. 6—As This Same Room Appears Today, As the Result of Incorporating Modern Design Materials and Fixtures

to be shown the bathroom first. If the bathroom was clean, I would usually take up rooming as I could be reasonably sure that the rest of the house would be clean too. Toilet facilities in old stations have the same effect on many passengers. Therefore, they should be carefully improved.

Illustrations 5 and 6 show the interior of the old and remodeled toilet room for men in the Milwaukee's passenger station at Milwaukee, Wis. I am sorry that I cannot show you these facilities in their natural color. You may rest assured, however, that the usual drabness and coldness of the typical old washroom is definitely wiped out by a striking and correct color treatment.

Another point of faulty design in station design is the incorrect location of the ticket office and lack of consideration of its appearance. The ticket office should be located at the end of the main traffic lane. Today, however, in most stations, the ticket office is located somewhere in the wall and is really nothing more than a hole in the wall. To make this worse, this hole usually has a grille over it, which, in itself has a very detrimental effect upon patrons. Imagine buying a shirt, a necktie or a pair of shoes through a grille; then why should we sell tickets through a grille? An open counter, while ideal, is not always practicable because of the flexibility that a ticket office must have to take care of both slack and rush hours. In Minneapolis, we solved this situation by having window openings which can be closed off or opened with roller shutters.

The function of a modern railroad station is entirely different from what it was 30 to 50 years ago, when most of our stations were built. In those days, a man about to take a railroad trip was brought to the station in a horse-drawn vehicle, or he walked, and usually the whole family came along to see him off. It was a big event and, therefore, warranted the proper setting in a large and impressive building. Today, the man, rushed to the station by taxi or bus, hurries in and goes immediately to buy his ticket and then to get on a train. The same haste prevails when he arrives at a station. To take care of this kind of traffic is one of the functions of streamlining the station—to get patrons in quickly and to get them out quickly.

Parking Area An Asset

In studying the Milwaukee's station at Madison, Wis., one of the first things that struck me was the fact that there was a useless lawn in front of it. This lawn added nothing to the beauty of the surroudings of the station, and was an economic loss because it had to be maintained. I reasoned that if we paved this lawn area, we could park 40 to 50 cars. In other words, we could practically assure our patrons they would find free parking space at this station.

Today, many of our old stations are too large. We no longer need these large accommodations because of the hurry of the passengers who "breeze" through them. This often permits the railroad to take over some of the unused areas for office space for its clerical staff, with a possible saving in rent and maintenance.

Correct lighting around the outside of an old building, besides its

functional advantages, can completely change the appearance of the exterior. In some cases a well-lighted marquee can completely blot out the upper and older part of a building. Unquestionably on rainy nights, people will be attracted to warm, glowing marquees under which to board or alight from taxis, and, incidentally, they also effectively advertise the railroad's services.

The question of whether to rehabilitate a station or to build a new one can be decided only after careful consideration of local conditions, especially the receipts at the ticket office. In this, the prospects of the future should not be overlooked. Sometimes, due to the relocation of lines or other causes, new stations must be built. As I have already pointed out, parking space is very essential. Likewise, it should be landscaped. The station building itself should have an impressive approach—I said impressive, not expensive.

Improved station locations, parking facilities, pleasing and convenient interior facilities, and the general good will of the public that can be brought about by an appeal to community pride, are important assets, which, combined with improved train service, can be used effectively to recapture lost traffic or to develop new traffic. We should all realize that through the strategic locations of our stations, through tradition and habit, and through the tremendous appeal of speed, with safety and comfort, the railways still have a strong position in transportation. At the same time, we should not forget that this position can be held only if every available modern medium is used to impress the man in the street with our services, including newspaper advertising, well-designed comfortable stations and well-designed, fast modern streamlined trains. All of these are good advertising, and advertise we must if we are to develop new traffic and are to regain some of the traffic that we have lost in recent years.

DISCUSSION

President Bechtelheimer: Mr. Kuhler, we certainly thank you for your fine talk. I am sure you will be glad to answer any questions that we may wish to ask.

E. T. Howson (Ry. Eng. & Mtce.): I would like to ask Mr. Kuhler if these improvements run into any large sums of money, relatively speaking, or if they can be expected with modest expenditures?

Mr. Kuhler: My experience has been that most of you gentlemen built too well. You built for 100 years. With modern materials that are readily applicable and easily maintained, and that have a reasonably long service life, such as plywood and other wall and ceiling facing material, it can be done at a very reasonable cost, if we do not get too ambitious and become involved in too many structural changes. If we do the latter, naturally we run into money. I am trying to avoid that in my designing.

L. E. Peyser (S. P.): Mr. Kuhler has covered the question so well that there is little that I can ask. We are all familiar with these

new materials. It merely takes a genius to know how to apply them properly.

E. Colclough (A. T. & S. F.): We have so many stations with low, overhanging eaves. Can we do anything to eliminate them?

Mr. Kuhler: No, you can't do very much with such eaves on an old structure. Sometimes you had better cut up such structures and build something new, because most of them are going to pieces anyway.

E. C. Morrison (S. P.): I live in San Francisco, Cal. For the last week I have done a lot of commuting out of Philadelphia, Pa. I have been struck by the illuminated signs on the Pennsylvania. When you pass a station and see Meadville, for example, you can look at the time table and know where you are and what time it is. I want to compliment the Pennsylvania men on the way they mark their stations.

Mr. Kuhler: That is right. They have done the best job in the country that I know of.

M. A. Higgins (C. & N. W.): I would like to ask Mr. Kuhler if he has found much difficulty in using the new modern motif along with the classic Renaissance or Roman that most of us have in our old stations? Many of our old structures were designed by architects of their period. The question in my mind is, how is it possible to fuse the modern, streamlined, straight-lined motif with the classic and heavy types familiar to us through the last 35 or 40 years—the interior especially?

Mr. Kuhler: That is just where I come in. (Laughter.)

President Bechtelheimer: In other words, get Mr. Kuhler,

R. D. Ransom (C. & N. W.): It seems to me that lighting is one of the features that go along with streamlining. We will have to get over the idea of putting in 25-watt lights and go to something that sets off what we have done, when we streamline. It may be a little hard on our managements for a while, but I believe they are coming to it.

Mr. Kuhler: That is very easy today with fluorescent light. This type of light is much lower in maintenance cost and does a better job. Of course, it is easy to make a mistake if we just go to a store and buy some fixtures, because fluorescent light is not like a light that comes from a center, like an incandescent bulb, but comes, I might say, from a continuous line—like, for example, a Neon lamp. Its fusion and distribution of light is entirely different from that of the round bulb, and we must allow for that in our design. But, as you have very well indicated, it gives us the opportunity to have the continuous line of light that we did not have with bulbs.

Mr. Howson: Mr. Kuhler spoke of fluorescent lighting being lower in cost of maintenance and operation. Is it very expensive in first cost?

Mr. Kuhler: Yes, it is, at the present time. It is not entirely licked, but the lamp manufacturing companies have promised me that it will be before long. Frankly, it is not so hard to use fluorescent lighting in a building, but it is still very hard to use it on a train. It has not been as entirely satisfactory as I had hoped it would be.

W. H. Pryor (St. L., S. F.): I would like to ask what size sta-

tion it is practical to streamline; that is, in about what size cities?

Mr. Kuhler: I collaborated with the B. & O. on a very small station costing about $7,000, and in that case I could go even further than the road in reducing costs. All we would have to do is buy prefabricated frames, which would permit erecting the station very fast. If we need to adjust the building in size later, we could add a couple more frames to it, or take a couple of frames off. Of course, in any case, the appearance would have to be designed and the colors worked out, but streamlining is practical for stations of every size.

Don't forget that I said in my talk that most of our present depots are too large because people don't loiter around them any more. They get in and out much quicker.

N. D. Howard (Ry. Eng. & Mtce.): I don't want to appear to be too conservative about architectural design, but I wonder if it is possible to go too far in the streamlining of a passenger station, especially the small ones. I am thinking of the early streamlined, or modernistic, furniture we had, which has gone out of style. It occurs to me that some conservatism might be in order on some of these passenger stations so that within 10, 15, or 20 years they won't be marked buildings as of an era of extreme.

Mr. Kuhler: To show how completely "screwy" we can turn in design, we have the buildings of the World's Fairs. We would certainly not go that far in a station.

Mr. Howard: I notice in at least one of the buildings where you most successfully modernized an old station, you made extensive use of white paint. I noticed again on the West Coast another large passenger station which has its complete interior in white. Is that a practical color for the average station from the standpoint of maintenance? How do you take care of such a finish?

Mr. Kuhler: I can answer that indirectly, Mr. Howard. I talked to a railroad president in 1928 who had been so daring as to paint his train a different color. Immediately his maintenance department found difficulties in keeping it clean and complained to the president about it. His answer was: "What do we want? Do we want a train that is easy to maintain, or a train that people like to ride on?"

In regard to maintenance, through air-conditioning, or semi-air-conditioning, we have better control of dust and smoke in the air than we had before. I also find that city smoke ordinances have eliminated a lot of smoke in stations. Don't forget another point —that many of these stations were at one time white, but have become dark through lack of maintenance.

Mr. Howson: Mr. President, at the risk of speaking again, I want to say that Mr. Kuhler set up another thought in my mind. I am wondering if we realize the amount of waste space that we are maintaining and perpetuating in our stations today, at a real expenditure of money. That is suggested by an experience I had last Thursday when I was on an inspection of a railway in Illinois. We stopped to look at a station that was being rebuilt—a station some 70 years old, structurally in good condition. They are taking out the interior walls of that station and entirely re-arranging

it. It is in a town of less than 10,000 population. They are consolidating within the walls of that station the functions or activities of four buildings. They had a large express room in the old building, which was entirely too large for present traffic. It is no longer used for storage, so they have converted part of it into an engineman's locker room. They are also putting a sub-dispatcher's office in part of the old, large ticket office. As a result, they are able not only to centralize all of those activities within the walls of that one building, but they are able to eliminate three other buildings and still do all the work that was being done in the four buildings.

Mr. Kuhler: That is what I had in mind before when I said in my talk that we were doing this in Des Moines. We had a restaurant there that was occupying too much space. I insist that a railroad is not in the restaurant business. They should give travelers the facilities necessary, but no more. By cutting down the size of the restaurant at Des Moines, we gained the additional office space needed.

There is another thought. You will notice that many waiting rooms—for the sake of impressiveness, and for that reason only—were built with high ceilings, 40 or 50 years ago. It is entirely possible to put an extra floor in them to get extra floor space. That has been under consideration in several instances. In most cases, the structure can carry it with a little reenforcement.

Protecting Steel Structures from Severe Corrosion

Report of Committee

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A. M. Knowles
Chairman

Let us determine first what the term "corrosion" means as applied to steel structures. The word "corrosion" is derived from the Latin word, Corrodere, meaning to gnaw. Webster defines corrode as: "To eat away by degrees; to wear away or diminish or destroy small particles of, as by the action of a strong acid or caustic alkali; to consume; to wear away; to impair." From this definition, we may infer that for steel to corrode, it must be attacked and wasted away.

We know from experience that corrosion, unless checked, will rapidly impair steel members of structures to such an extent that partial repairs, or complete replacement, of members, and even of whole structures, becomes necessary. In order that we may understand better what types of materials may be applied to retard or prevent this destruction, it seems advisable to consider the fundamental factors causing corrosion.

Ionization of Metals

Pure water is composed of hydrogen and oxygen. The forces that bond these two elements together to form this chemical compound are electrical. Hydrogen (positively charged) unites with oxygen (negatively charged), the two being held together by the mutual attraction of their electrical forces, forming a neutral compound.

The smallest unit of an element which can enter into a chemical change is called an *atom*. In the normal state, an atom is electrically neutral although surrounded by an electrical field composed of an equal amount of both positive and negative charges.

When in combination with other elements to form stable compounds, all elements are in the atomic, or neutral, state. However, an element entering into a chemical union, or leaving such a union, must be electrically charged, either positively or negatively. An element becomes positively charged by losing some of its negative forces; or negatively charged by absorbing negative forces from another

element. In this state of electrical unbalance, the particle is called an *ion*.

Metals always become ionic when going into solution in water, water providing the medium by which the electrical forces are transferred. This fact explains why corrosion of metals cannot take place unless water is present. Metals in the ionic condition are always positively charged.

All metallic elements are soluble in water but vary in their rate of solubility. The solution pressure, or comparative speed of solubility, has been accurately measured. The more common metals are listed below in the order of their solvency, or their tendency to go in to solution. For example, potassium goes into water solution so rapidly that it creates both an explosive and a fire hazard.

1. Potassium
2. Sodium
3. Magnesium
4. Aluminum
5. Zinc
6. Iron
7. Nickel
8. Tin
9. Lead
10. Hydrogen
11. Copper
12. Mercury
13. Silver
14. Platinum
15. Gold

Hydrogen is included in the above list in the direct comparative order of its solubility because, although not a metal, is reacts chemically in a similar manner. As we shall see later, hydrogen causes corrosion of any metals having a greater solubility than itself.

When hydrogen ions dissolved in water come into contact with metal of greater solubility, the metal is thrown into solution; that is, the positively-charged hydrogen ions pull negative charges away from the metal atoms, which previously had been surrounded by a balanced or neutral electrical field. Having lost negative charges, the metal atoms become positively charged, are in the ionic state, and are thrown out into solution.

Hydrogen ions are essential to, and initiate, all types of steel corrosion.

Rust, ferric oxide, is caused by relatively small amounts of hydrogen ions contained in atmospheres reasonably free from smoke. The presence of oxygen is necessary to complete the final precipitation of rust. The accumulation of true rust is a comparatively slow process.

Complete rust removal is desirable before painting steel with a drying type film. If it becomes necessary to paint over common rust, good paints will probably give reasonable results because, under warm dry air conditions, little moisture or acid hydrogen ions will be trapped under the film.

Sulphuric Acid Corrosion

When coal burns, the sulphur content unites with oxygen to form a gas called sulphur dioxide. This gas unites with water that is present in steam or in the atmosphere, and forms sulphurous acid. Sulphurous acid unites with additional oxygen to form sulphuric acid. Sulphur leaching from coal also forms this acid.

Pure concentrated sulphuric acid contains no water and boils at 540 deg. F. as compared to water at 212 deg. F. Under hot, dry atmospheric conditions, dilute sulphuric acid will lose water and become more concentrated. On the contrary, pure concentrated sulphuric acid has a great affinity for water, and will absorb and retain it in large quantities. Consequently, under railroad conditions, some acid is always present and is generally in a diluted condition.

The mixture of pure sulphuric acid and water dissociates the acid. The hydrogen separates from the other elements and goes into water solution. Dilute sulphuric acid is therefore highly corrosive to steel because the positive hydrogen ions in contact with the atoms of iron in steel force the iron out into solution. The steel is continuously and rapidly eaten away

because the acid contains an unlimited supply of hydrogen ions.

On exposed structural areas which can be washed by rainfall, some of the acid may be carried away. On unexposed sections this is of course impossible, and liberal amounts of dilute sulphuric acid may always be found on such areas which are subjected to excessive smoke conditions.

Salt Corrosion

Sodium chloride or ordinary salt rapidly dissociates in water. The solution is highly ionized because of the great solubility of sodium and chlorine. The sodium carries the positive charge; the chlorine the negative charge. The water in the brine solution also dissociates into *hydrogen ion* and hydroxyl ion. The dissociation is so complete that billions of ions are concentrated in a cupful of brine.

As atoms go into solution, a back pressure develops which tends to prevent additional atoms from coming into solution. Maximum resistance is obtained when the solution becomes "saturated." If by some means part of the ions are removed from the solution, additional atoms will come into solution. The presence of chlorine ions accelerates the rate of corrosion of steel because the chlorine ions rapidly unite with the iron thrown into solution by the hydrogen ions. Due to this ready union, the resistance pressure is kept at a minimum, and additional iron ions come freely into solution.

Another reason why salt accelerates corrosion of metals is that brine is an excellent electrical conductor because of the high degree of its ionization. An additional factor is that chlorine is a tremendously active element. That is, although it has a greater natural affinity for the sodium ion, the chlorine ion will readily unite with the iron ion.

Causes of Severe Corrosion and Parts of Structures Affected

Reports from previous committees and from members of this committee, as well as statements recently received from many railroads, indicate that the major causes of severe corrosion, in the order of their importance as destructive influences on railway structures, are as follows:

(1) Brine and urine drippings from cars.

(2) Gas, smoke and cinders emitted from locomotives.

Protecting Their Steel Structures Against Corrosion Is One of the Large Problems of the Bridge and Building Forces

(3) Coal, cinders, debris and dirty ballast, accompanied by moisture.

(4) Salt water or fogs, and salt water spray.

(5) Dampness in unventilated places where sunlight is excluded.

(6) Ordinary water.

(7) Ordinary atmosphere.

It is quite generally accepted that railroads carrying heavy refrigerator car traffic find brine to be the outstanding cause of corrosion. The main line of nearly every railroad and, to a lesser degree, some branch lines are affected. Urine has about the same effect as brine because it contains salt as well as acid, but only a comparatively few railroads hauling heavy stock traffic are severely affected by urine. Steel work in large shop, freight and similar structures is sometimes severely corroded by the urine of employees.

Brine is doused on bridge steel over the area between and extending about three feet outside the rails. Corrosion is intensified on bridges in and adjacent to yards and terminals, and on bridges located on curved track because the jostling of cars when starting, and their tilting on curves releases a greater volume of brine. Ballasted floor bridges are less affected by brine than open floor bridges.

Acid-forming gases, smoke and blasts from locomotives, affecting bridges or structures over the tracks, are the second greatest source of corrosion. The less the clearance over the tracks, the greater is the damage. Their effects are augmented by pockets in the underside of such structures which prevent the gas and smoke from escaping. Such corrosion is intensified when locomotives stand or pass frequently under structures in yards or terminals. When such overhead structures carry railroad tracks, and are also subjected to brine from above, a doubly severe corrosion problem is created.

Other miscellaneous structures affected by severe corrosion are smoke stacks and ducts at power houses, water tanks, train sheds, steel sash, signal bridges, turntables, steel coal pockets, track coal and ash hopper beams, track scales, and various other terminals facilities where steel members are subjected to gases, cinders, dust, dirt and moisture.

The effect of corrosion on all of these structures is ultimately the same, namely reduction in section. The outstanding legs of angles in the top flanges of stringers and girders are weakened by loss of section and often develop longitudinal cracks along the fillets of the angles; occasionally half moon shaped sections break out, probably because of reduction of section and consequent overstress. The lateral angles in deck bridges sometimes become so thin from corrosion that they snap off under vibration. Many other conditions could be cited to show the far reaching effects of corrosion.

Eliminating the Causes of Corrosion

If the causes of corrosion could be eliminated at a reasonable cost, our problem would be solved. Various methods have been practiced and suggested. Brine results from the use of salt and water ice in refrigerator service. Some cars are equipped with brine retaining tanks which are supposed to be drained at designated places. Unfortunately, this equipment becomes defective and, until repaired, permits the brine to drip while in transit. Many refrigerator cars are equipped with ice bunkers from which the water is free to drip at will. Salt, while not always used in these ice bunkers, is necessarily used in thousands of cars and constitutes the greatest menace to steel bridges.

Consideration has been given at various times to the possibility of equipping these bunker cars with brine tanks, but the American Association of Railroads has found that this is uneconomical for the following reasons:

(1) Only a small percentage of the refrigerator cars in daily operation are treated with ice and salt.

(2) The added weight of the containers, as well as their cost, is quite objectionable from an operating point of view.

The Association of American Railroads is making tests on the introduction of a solution of sodium dichromate into the brine as an inhibitor, which, if it proves effective, will alleviate this trouble. Mechanical and dry ice refrigeration have heretofore been considered too expensive, but an article in the August 3, 1940 issue of the Railway Age shows great possibilities in the use of dry ice in coordination with water ice without the use of salt. It is claimed in this article that this system can be used in refrigerator cars without change, is more efficient, and costs no more.

As long as coal burning locomotives are in service, there is little possibility of eliminating smoke gases and cinder blast, which constitute the second greatest source of corrosion. With electric and diesel engines coming into more general use, it is to be expected problems will diminish proportionately.

Frequent removal of cinders and of dirt laden with moisture will eliminate many acid corrosion problems.

A few roads have resorted to the use of several devices to reduce the damaging effects of brine on open floor bridges. Among these are the following: Metal troughs or timber spacing blocks between the ties are sloped to throw the brine off the steel work within the limits of the decks. Creosoted timber raising pieces are placed longitudinally on stringers or deck girders and under the ties and extend over the edges of the flanges. Wrought iron and alloy steel plates, and fabrics saturated and mopped with various coatings are also employed in this manner. Formed galvanized sheets are used over cross frames and laterals. Many other methods are in use.

To protect structures over tracks, "blast plates" are suspended from or attached to the structures. Some of these consist of alloy steel, wrought iron, cast iron, ingot iron with a bituminous mat on both sides, or creosoted timber and concrete slabs. Special coatings of paint with grit embedded and Shotcrete encasing steelwork are also used.

When corrosion has destroyed parts of bridges beyond a safe limit, many novel methods of repairs and renewals are employed. Some roads employ alloy steels. Others use excess material to allow for future reductions. The many phases of this work and details of repair are very interesting, but space here does not permit lengthy discussion.

Application of Protective Coatings

At least three railroads have metallized some steel structures. In all cases the steel to be coated was first cleaned by sand blast. The coating was then applied by a gun, operation of which requires compressed air, oxygen, acetylene and metal wire, the wire being fed into the gun, melted, atomized and sprayed, all in one process. Zinc, aluminum, tin, lead and cadmium are the metals commonly used for corrosion resistance.

Several railroad bridges have been so treated with a zinc coating, one as early as 1934. One road reports the total cost as ranging from 50 cents

to 65 cents per square foot. Another gives the cost of treating a 50-ft. deck girder span before it was installed as $114.75 for material and $350.31 for labor. A boiler stack was given a lead coating on the inside and aluminum on the outside. A switch tower was also treated with a zinc coating. It is reported that these coatings have been quite successful to date, but too expensive for general use unless their service life proves to be proportionately longer than that of the paint.

A few roads have installed electric devices in steel water tanks to avert corrosion of the inside surfaces in contact with water. Your committee has no reports on the success of this device. The A.R.E.A. Committee on Water Service, Fire Protection and Sanitation will present a special report on this subject at the next convention, which should be of interest to maintenance men.

A report presented last year stated that "To stay or remedy the effects of deferred general painting, maintenance men have resorted to spot painting, touching up those parts of their bridges that are exposed to either brine or to locomotive gas action, when required. In doing this spotting, many roads are using special coatings such as bridge cement, crude oil, asphalt oil, black oil with an asphalt content, slushing oils, asphalt paints, tar paints, asphalt roofing compounds, grease-like rust preventatives and rust removers, rust inhibitors, and rust emulsions."

A recent re-check with a large number of railroads, well distributed throughout Canada and the United States, substantially corroborates the above quotation. These products are largely non-drying types of materials. Considering that drying type films have been used on steel structures for so many years, there must be a good reason why maintenance men are resorting to such a variety of coatings of another character.

A perusal of previous committee reports of this association and recent statements from many maintenance officers of railroads reveals that results reported for any one protective coating are not always the same. Differences of opinion also exist as to the relative merits of the many different kinds and types of protective coatings. The question arises why this should be so, and also how we may take best advantage of the materials available.

Many men charged with the selection of protective coatings have more or less knowledge of the fundamental factors causing the several types of corrosion, and understand the fundamental chemical and physical properties of paint films. However, there are a considerable number of these men in general charge of painting programs, and still more of the field men who actually direct the work on the job, to whom these features are still somewhat of a mystery.

The latter may, for this reason, take less interest in the problem than they would if they had a better understanding of the fundamental factors. Yet the success of any material used may depend largely upon the care and understanding with which it is applied and "lived with" on the job.

The paint chemist formulates a variety of paints to combat the various agencies destructive to steel. Many types of pigments, oils and resins are employed in an effort to meet the requirements of a given condition. Maintenance men, confused by this situation, have relied too much on the claims of manufacturers, without giving consideration to many of the practical and technical aspects of the properties of protective coatings.

Properties of Protective Coatings

Previous reports mention the use of drying and also non-drying types of protective coatings. A drying type film is one which eventually reaches a condition of brittle hardness at the expiration of its effective life, while a non-drying film retains its oily-wetness as long as it exists, that is, until it is weathered away. Careful investigation discloses that each is particularly fitted for a specific purpose.

Drying Films

We learn from the United States Government Forest Products Laboratory, that drying-type paint films are never entirely waterproof, their efficiencies ranging from 18 per cent for three coats of linseed oil to a maximum of 98 per cent for three coats of the best paints. Chemically-laden moisture will pass through these films in proportion to their degree of waterproofness.

Chemically active pigments are used in steel primers in an attempt to inhibit the chemicals which pass through the films and nullify their attack upon the steel. In order best to utilize their inhibitive qualities, it is necessary that we use a highly waterproof film which will remain so for a long period of time. Many paint films of high initial moistureproofness lack the ability to retain their waterproofness after a short period of exposure.

The passing of an excessive amount of moisture through a pigmented film is detrimental for several reasons. If the pigment is highly soluble, it will be dissolved wastefully and although its degree of protection will be excellent for a short time, it quickly loses its effectiveness because the supply of pigment is soon depleted. If the pigment is only slightly soluble, insufficient amounts will go into solution to offset the corrosive action of the moisture passing through.

Chromated pigments, such as zinc chromate, possess powerful inhibiting properties. In water solutions they form a thin transparent non-magnetic oxide film on steel which is impervious to acids or salts of any concentration. This barrier is mill scale such as found on hot rolled steel. The thickness of the chromate formulated film is microscopic. It is subjected to the same expansion stresses as ordinary scale but the fractures are readily resealed as additional chromate goes into solution.

Acids are neutralized by alkalies. The positive acid hydrogen ion (H^+) combines with the negative alkaline hydroxyl ion (OH^-)to form neutral water (H_2O). In the form of lead or zinc oxide, either unites with water which passes through the film to form the alkaline radical (OH^-).

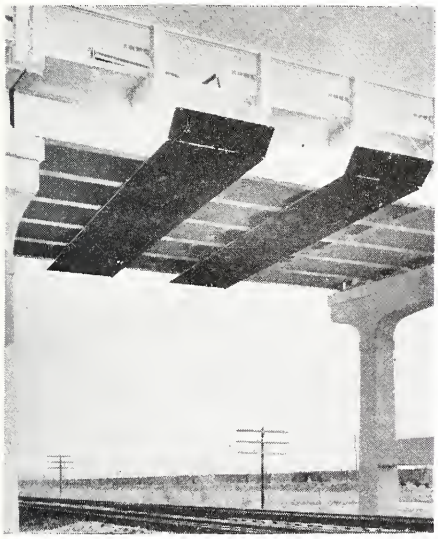
Drying type films, which are highly effective when applied over properly cleaned steel, lose much of their efficiency when applied over salt or acid corrosion left beneath them. The inhibitive properties of the pigments are generally taxed to capacity in inhibiting any chemically-laden moisture passing through the film, and therefore cannot exert sufficient influence to overcome the effect of chemicals under them. Chemicals beneath the film eat away the steel rapidly and undermine the film above. Obviously, best service from drying type films will be obtained when they are applied over well-cleaned steel.

Generally, drying films applied over clean steel do not fail primarily because of moisture passing through the film, but more often because the chemicals gain access at cracks and fissures and eat away the steel more or less rapidly, undermining the film.

Non-Drying Films

Uncleaned, chemically corroded surfaces seem to be most effectively protected by non-drying films. Due to their oily-wetness, they penetrate the rust completely. The particles of chemically-laden rust are surrounded and isolated. In a manner, the position of the rust is relatively an exterior one, that is, it is not in contact with the steel and does not lie beneath the protective coating.

Primarily, the actions of the non-drying coatings are physical. They are free throughout their life to advance into cracks and crevices, and to seep into rust. Moisture will retreat



Panels of Suitable Materials Are Used Effectively to Protect Overhead Structures from Locomotive Blasts

from an oily-wet film so that undermining is reduced to a minimum. The films are self-healing and highly moistureproof. They do not soften or hydrolize under continual water submersion, as do the drying films.

The non-drying coatings are effective rust removers and exert their protective influence without the necessity for costly cleaning. They are comparatively inexpensive and are economically applied in a single heavy coat. They give good protection under conditions which are ruinous to drying films, regardless of their qualities or their thickness.

Moisture pockets created by structural design present a great problem in conjunction with the drying type films. When the non-drying films are used, these pockets serve as reservoirs for liberal amounts of the coating and continuous oil-wetting of the steel is assured. Even though the non-drying coatings need be applied at more frequent intervals, their great economies appear to justify their use under the more severe corrosive conditions resulting from acids and salt brine.

A maintenance officer of one of the large railroads, who has used one of these materials, states that "we do not know how we could have preserved our bridge steel to anything like the degree we have done since 1932 without having gone to the use of these products. By their use we have extended protection to a fair degree to as much as 5 to 10 times as much steel as we could have protected by the old method of painting."

Conclusion

The protection of steel railroad structures against severe corrosion is one of the maintenance problems which requires constant, painstaking attention. This includes the selection, the application and the care of protective coverings. No matter how suitably formulated the materials may be for a specific type of corrosion, their effectiveness depends largely on their application in a proper manner, to suitably-prepared surfaces, at the right time.

Reports from many railroads indicate that the degree of attention varies over the country. Where corrosion is not excessive, or is not allowed to become acute before it is given attention, no serious harm results. Where neglect or inattention has permitted serious inroads on vital parts, expensive structural repairs or renewals are often necessary.

Some railroads continue to use dry film paints on parts of steelwork attacked by brine and gas with reasonable success, while others have poor success with such coatings. The use of non-drying coatings is apparently gaining favor at present for parts affected by brine. Only time will tell how satisfactory any of these materials will prove to be. There is evidence that a real effort is being made by maintenance officers and their subordinates to find the best possible solution of this problem.

DISCUSSION

President Bechtelheimer: Mr. Knowles and Mr. Johnson, it has been said that your committe has made a new approach to an old problem. You have made it clear that we can not solve our paint problems unless we use paints developed to meet the particular conditions encountered. One kind of paint will not be good for all conditions.

E. C. Neville: (C. N. R.): This is a very important subject and the report has been well prepared. All of the railroads on this continent have been faced with the very serious problem of protecting their steel structures during the depression.

In my own particular case, several years ago I began to get alarmed about what might happen if our earnings would not soon permit us to take painting work in hand extensively. On my own, I started spraying oil on the rusted and corroded portions of our bridges and have kept this up annually. I have found the oil so cheap to apply that I was able to go over all of the bridges in my territory every year. After the first year's application, I found it necessary to apply the oil only on the most exposed parts of the flanges and girders, and in the corners where cinders and dirt would collect.

In the last three years this work has cost us six cents a lineal foot of single-track bridge for labor and material. The result has been that the bridges over which I have jurisdiction have been kept free of rust and scale.

The year after our bridges have been given a coating of oil, we apply a prepared grease compound which is well known on the market. One reason why we adopted this material was because six years ago I applied some of it on a very much exposed portion of a bridge and today that bridge is still in perfect condition, without any attention having been given to it.

There are some bridges, of course, on which we can't use a grease compound; where it is necessary to clean off the old loose paint in the usual manner. We have reduced the cost of such cleaning considerably by the use of a flame descaling torch. We find it is much cheaper and quicker and involves less equipment to handle than sandblasting or using a rotary brush. Flame cleaning is a simple

matter and painting can follow the cleaning immediately.

A. B. Chapman (C. M. St. P. & P.): I would like to ask what experience others have had in protecting steel piles where they are not encased at the ground line.

Mr. Neville: We have found this same grease compound very satisfactory for that purpose, and also when placed around the base of columns where moisture and cinders collect. It takes care of the difficulty very nicely.

Mr. Chapman: I refer particularly to stream beds, where the action of sand and gravel will readily cut away almost any protection that is put on.

J. S. Huntoon (M. C.): I would like to ask Mr. Neville if the bridges to which he referred were ballast floor bridges or open deck bridges, and if they are on a division where refrigerator cars are hauled; also, if he used ordinary track oil? How much longer would it last than three years? Was the cost of six cents, per foot of track? If it was a truss instead of a regular girder span, I doubt whether the same conditions would prevail.

Mr. Neville: Our bridges are mostly of the open-deck type, Mr. Huntoon, and the ones I referred to are on our main line, where we have heavy brine traffic. I tried to make it clear that after we had thoroughly coated the rusted portions of a bridge, the only parts that we had to recoat annually were the more exposed parts, such as the tops of the girders and in between the ties where the weather and drippings would affect the steel. The material put on the more protected parts has been on for five or six years and is still moist and alive.

Mr. Huntoon: In other words, you can get from five to six years service out of the track oil that you coated them with?

Mr. Neville: Yes, in the protected portions of the bridge, but not on the top surfaces which are exposed to rain.

Mr. Huntoon: Then your bridges have to be patch-oiled occasionally?

Mr. Neville: Yes.

President Bechtelheimer: We haven't given Mr. Chapman an answer to his question.

G. W. Rear (S. P.): I think I can. I have studied this paint question for a long time, I have talked to "17,000" paint salesmen and I know all that they know.

For the protection of steel piles in a river bed, there are two ways. One, of course, is to put a concrete coating on them, a few inches thick, either by guniting or by encasing them. The other is to apply mastic enamel. The mastic enamel will be perfectly satisfactory, but is not as easily applied as concrete. But the concrete will do well, too.

Now about bridge painting. The matter came to my attention very seriously one time, when we had just finished a 12 million-dollar bridge. Full of pride, we opened it for traffic ten years ago yesterday. I was walking over the bridge with Mr. Holden, who was then Chairman of the Board of our company. He said to me: "How long is she going to last?"

I said: "Mr. Holden, if every fellow that comes after me does as well as I will do to take care of it,

she will be here 500 years from now."

He said: "Do you think it is possible?

I said: "I do."

There are a wide variety of climates, and they have a wide variety of effects on paint on bridges. We have bridges that would last almost forever without ever having been painted. There was one on our Texas line, that was built in 1892. When it was rebuilt, some of the steel girders from the old bridge were left in a pile, pending disposal. After 24 years, the shop marks on the original painting could still be read. No corrosion had occurred. There isn't a manufacturing plant within 600 miles of that point. It is one of those territories where you wonder why it never rains; and that is the reason the paint lasts so long.

There are other places where corrosive conditions are much more severe. A number of years ago a vessel bumped one of our spans into the ocean where it laid a year before we were able to get it out. When it was taken out, it was covered with marine growth three or four inches long, which very rapidly shrunk to about a half-inch in length when it was taken out of the water. This bridge had been painted with two coats of red lead which had been on a long time, and had been coated with a top coat of carbon black. In our attempt to clean this bridge of the marine growth, the carbon black all came off, but the red lead coats that had been on there many years were intact after a year's submergence in salt water.

That gave us confidence in the belief that red lead paint is all right if we once get it on right. There is no time to paint a bridge as good as the day you buy it. When it is first painted is the only time it will ever get a real painting. I still think that if you had to maintain a bridge for 500 years, you would do best to first design the bridge so that there would be no places that you could not paint; then, that you would thereafter keep to one kind of paint.

I believe that lead and oil paints will leave a bridge, after 50 years, in better shape to take more paint than any of the other varieties of paints that you might put on from time to time through the persuasion of salesmen. We tried some asphaltic paint once, and it was unfortunate because it was impossible to buy that paint again, and impossible to apply any other paint over it. It had to be cleaned off in order to put on a new paint. So we have developed a practice like this: wherever a bridge will stay painted five years or more with standard paints, we repaint it in a standard way, using as a basis two coats of heavy red lead and carbon black or graphite.

Incidentally, we once made 72 tests of various paints in a bad location and when the tests were over, we found four outstanding paints, three of them being graphite, and one a carbon black; all of them being well-known paints, that is, from well-known national concerns. So we have come to the conclusion that there is no particular advantage between graphite and carbon black for a finish coat.

Our policy is that where a bridge will stay protected with paint for five years or more, we repaint it. We try to paint those places where the other fellow never attempted to paint, that is, up in the hips and in the top corners where there is no possible way of standing or of

recleaning or repainting. In these places we squirt in this non-drying compound, much as you would with a garden hose. In this way we believe that these places will always be, like Caesar's wife, "above suspicion."

For bridges where paint will not last five years, we coat them with this non-drying compound, and have been very successful with it. However, we do paint our bridges once. That is, if we are putting a new bridge in the worst possible place we would give it the standard painting first. Then, when it needs repainting, we put on a single coat of non-drying compound and follow it up from time to time.

Four years ago we painted 28 bridges in very bad locations with non-drying compound. Investigation has showed that they are still in good condition.

In San Francisco we have a very serious condition with the Trans-Bay and Golden Gate bridges. From the standpoint of painting, no bridge could be located in a more severe place than the Golden Gate bridge. The estimate for painting this bridge is $100,000 a year. Most of us could do a lot of painting for that. They tried every way (even consulted me) to paint the bridge best. They did everything that was possible, I think, to paint that bridge in a first-class, non-political way. However, it is going to take $100,000 a year to keep the bridge painted.

On the Trans-Bay bridge, which is probably the largest structure ever painted, they have a budget of about that same amount of money for painting. Their bridge was manufactured and shipped non-painted, with the expectation that it would take up some rust before it was ready for erection. Then, previous to erection it was sandblasted and painted with the first shop coat, this coat being applied only to the fully sandblasted surfaces. It cost them a million dollars to sandblast the steel, ready for this first coat, and there has been a considerable difference of opinion among us out there as to whether this money was well spent. However, if you will read some of the reports made by the Trans-Bay Bridge authority regarding maintenance painting, you will readily see that it is a very difficult matter. A young fellow is in charge of the painting, and if any solution of the painting is to be found, that fellow is going to find it.

At present, they are steam-cleaning all surfaces before repainting them. Remember, no corrosion will be allowed on this particular bridge, because it is intended to be another 500-year bridge.

I think there is one thing that we should always keep in mind, especially designers and that is, that in a bad situation, close to the ocean, a pin-connected bridge with hips full of bars and pins, has no place.

President Bechtelheimer: Mr. Chapman, did you get the answer to your question?

Mr. Chapman: It is not satisfactory yet.

President Bechtelheimer: Do you know of any other method?

Mr. Chapman: No, I don't know of anything that is absolutely sure. That is what I want to find out. I know that concrete encasement does not do it. We have found too many failures with it, and everybody else has also.

Chairman Knowles: I might cite the experience of the corru-

gated pipe people in painting their pipe. They experimented with all kinds of material to overcome scour. They found that a relatively soft material stood up better than a hard material. Therefore, I think the second suggestion of the previous speaker would probably come nearer to a solution than concrete casing, because concrete casing is hard and does scour.

R. D. Ransom (C. & N. W.): I am a believer in non-drying paint. However, I hear objections from the men who have to climb around on bridges that it makes them unsafe to get around on. I wonder if there is any way to overcome this hazard?

Chairman Knowles: I don't know of any, except to put it only on those places where you are not likely to slip. I think the advantage of non-drying paints is mostly where steel is affected most severely by brine or other similar corrosives, and if it is confined to those areas there is less chance for slipping. Of course, there is always an opportunity for men to slip on it.

J. M. Salmon, Jr. (L. & N.): With the use of oils rather than prepared paints or mastics, I think that users are going to find some deterioration in future years. Cheap oils contain a certain amount of acid and sulphur. Maybe over a period of from three to six years you will think you are getting good results, but under certain atmospheric conditions your results are likely to be worse than if you had used some other type of paint. Oils are cheap to apply, but I don't believe that over a period of 10 to 15 years you will get your money's worth out of them.

W. A. Sweet (A. T. & S. F.): With reference to what was said about slipping on the non-drying paints, we have found that to be worthy of consideration. We caution all men having to do with inspections of structures where we have applied non-drying paint never to lose sight of the fact that while it may be dry on the surface, it is still soft and slippery underneath. On a number of plate girders where the depth of the girders is such that it is impossible to walk through on the lower bracing and keep a hold on the bracing above, we have installed catwalks of creosote planking for the safety of inspectors. These are also of assistance when touching up the paint at a later date.

L. D. Garis (C. & N. W.): The corrosion that costs real money on the North Western is on the tops of stringers and girders on our line between Chicago and Omaha, Neb. I have inspected the bridges on this line several times. While I have an open mind as to whether these parts of bridges can be protected with any sort of paint, I am certainly very skeptical. In this territory, the worst corrosion occurs directly beneath the ties.

It appears to me that there are three causes of the corrosion under the ties. First, the tie is absorbent and holds some of the liquids that cause severe corrosion. Second, it is very difficult to apply any protective coating under a tie. Third, it appears that there are cases where there is actual abrasion due to grit, such as sand or cinders, working under the tie, between the tie and the steel.

So I am really pessimistic about being able to protect this condition beneath ties with some kind of oil,

at six cents a foot. The real solution, it appears to me, is to put on a steel cover plate. On the North Western, we have used these steel cover plates, riveting them in place; merely placing rivets between the ties and flattening the heads instead of countersinking them. This, of course, costs more than six cents a foot.

In talking this matter over with Mr. Knowles, he told me that on the Erie they weld these cover plates on. I understand that is less expensive than riveting. At least, he claims it is.

Chairman Knowles: The condition of the structure that you want to protect makes some difference. Where you have stringers without cover plates, it is a simple matter. If the flange angles of the stringers are not so reduced as to make them too thin to weld against, then it is a very simple matter to slide a cover plate on the top of the stringer and weld along the edge of the flange angles, connecting it in that way. Sometimes, where the edges are thin, it is necessary to cut the angles back to get proper thickness to weld against, but that is very simple too.

When you have to apply cover plates over flanges with cover plates that are riveted, that is a different matter, and it is more expensive. The decision then depends somewhat on operating conditions as to whether riveting or welding on the plates is cheaper. We have applied them both ways with success. I am not able to tell you what the comparative costs are, but they don't vary much.

Mr. Rear: There is another way of protecting these surfaces. Of course, the real way to protect the stringers and floorbeams is to put on a ballast deck. The spacing blocks that we use between ties are also helpful, but there is a cheap way on an old bridge, and that is, with painted canvas. Take about an 8-oz. canvas and make it, say, 6 in. wider than the flange, and then paint it on both sides; in fact, we soak it in red lead paint for a few days, then let it dry. Then we put it on over the top flange and under the ties; it is wide enough to shed water on each side. One application such as this will extend the life of the flanges, I would say, ten years.

Regardless of whether a bridge is painted with non-drying paint or with something else, catwalks should be supplied for proper inspection and convenience.

F. H. Soothill (I. C.): I wonder if any of the gentlemen here who have used the oil method of painting structures due to hard times have had any difficulty in getting these structures decently painted when times got better and they resumed regular painting?

K. L. Miner (N. Y. C.): Where we have used the non-drying oil, we have put on carbon black paint and have found it to be successful.

I would like to give you another figure on the unit cost of applying non-drying paint. Instead of 6 cents a lineal foot, I will give you a price of 40 cents a gallon. In that way you can figure the cost on truss bridges, or single- or four-track bridges. I believe the accepted price for hard drying paint is about $2.50 a gallon, so when you use oil at 40 cents a gallon, you can protect six times as much surface at the same cost. In applying oil no cleaning is necessary other than to remove dirt. The oil that we have been using costs about 9 cents a gallon. That leaves 31 cents a gallon for applying it.

The application has been made in a number of ways; by air-spraying, with large hand brushes, and sometimes with a large window brush on a long handle.

I would like to ask Mr. Knowles if he has any figures to show the loss per year in bridges in this country, expressed in dollars, as the result of brine drip.

Chairman Knowles: I have not. It runs into big figures however.

Mr. Miner: I would say it would be in excess of a million dollars.

Chairman Knowles: I would say many millions of dollars.

Mr. Miner: Obviously, therefore, we have an opportunity to justify our expenditures to prevent destruction from brine.

Mr. Huntoon: I would like to ask Mr. Miner how many square feet a gallon of oil covers?

Mr. Miner: In painting a truss bridge, I presume you lose 30 per cent of the oil, but the expense of this loss is very small.

Mr. Huntoon: Would that be 200 sq. ft., or 400?

Mr. Miner: I would say that a gallon of non-drying oil applied on a girder bridge where there is practically no waste, should cover 400 sq. ft.

Mr. Huntoon: Trusses less, I suppose.

Mr. Miner: Very much less.

Chairman Knowles: It is your practice, I understand, to use this material on all steel portions of the bridge, rather than on just the extremely corroded portions.

Mr. Miner: That is right; over the entire bridge.

Mr. Rear: Mr. President, to clear the record: Mr. Neville did not state that it cost him six cents a track foot to put on oil. He meant that for the total number of bridges he had painted over a period of years, it had worked out to six cents a foot. Many of these bridges had not been recoated, or at least had only been touched up in a minor way.

President Bechtelheimer: Mr. Knowles, I think we are probably justified in closing the discussion on this report. The committee is excused with the thanks of the association.

The Inspection of Buildings to Formulate the Maintenance Program

Report of Committee

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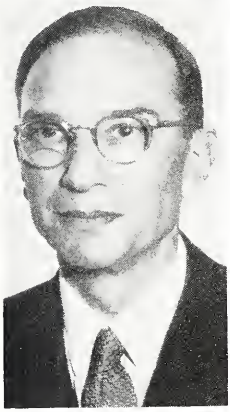


L. E. Peyser
Chairman

As the members of this association well know, the inspection of bridges, trestles and culverts is done in a systematic, thorough and detailed manner on every railroad. The safety of train operation depends to a considerable extent upon these inspections, which determine the repairs and renewals necessary during the year. During the last ten years, with their curtailed maintenance allowances, it has been necessary for the railways to concentrate on the inspection of bridges, trestles and culverts in order to avoid interfering with the operation of trains, either from the standpoint of safety or slow orders.

The inspection and consequent repair of buildings has, therefore, been curtailed to a great extent with the thought in mind that this is one place where maintenance expenditures can be cut down. It must not be overlooked, however, that even when reduced to the lowest possible level, the maintenance of buildings comprises a major expenditure and is, therefore, entitled to the same thorough study as other items on the maintenance program. A study cannot be properly made and a budget program formulated without the actual inspection of buildings to gain some idea of the work that must be performed and the amount of money that will be required and to permit the proper and orderly formulation of the field work. The preparation of a program based upon careful inspections should provide the greatest improvement in the most buildings at the least possible expenditure.

The responsibility rests with the head of the bridge and building department (the supervisor, master carpenter or other person who fills this position) for the safe and proper maintenance of buildings. He must know at all times that each building is in condition to meet all the requirements of safety and protection of contents (in persons, goods or

equipment), as well as of the building itself.

Information regarding the condition of a building can be secured only through periodic and detailed inspections by persons possessing a full knowledge of what is required. This work calls for good judgment, since it is not unusual to find that defective details, which on cursory inspection appear to be of great importance, are shown, on more careful investigation, to be not fundamental, while many defects that appear unimportant may in reality not affect one part alone, but the useful life of the entire structure.

Notwithstanding the fact that the head of the bridge and building department carries the primary responsibility for the condition of all buildings under his jurisdiction, he is not always in a position to formulate a complete building maintenance program, since there are other considerations which may either curtail or enlarge this program. The first consideration is the amount of money available for the maintenance of buildings and this is usually beyond the control of the local officers. Also, changes in operating conditions may dictate the necessity for heavier maintenance at some points, with corresponding reductions at others.

Office Representative Desirable

It is therefore highly desirable that a competent person from the general office representing the department most interested in developing the maintenance program, participate in the inspection that is made to develop a program for the work. It is not essential that this representative from the general office inspect every building each year, although this is desirable. The larger and most important buildings should, however, receive his attention. On the larger roads, where inspections require considerable time, because of the great distances between points, the line should be covered at least every two or three years. Changes in important buildings do not occur so rapidly that intelligent consideration cannot be given to the advisability of doing a particular piece of work if the last inspection has been made perhaps two years ago.

It is desirable also that one man representing the general office be assigned to this inspection work instead of having several representatives do it. The data collected over a number of years then become of increasing value, and afford a good progressive picture of conditions over the entire road.

No inspection of a building should be made without including in the inspection party the foreman or superintendent of the department using the building. This man should be familiar with the problems of occupancy and of safety in connection with his work. If this practice is followed consistently, the users of buildings soon become aware of the importance of the inspection and may even point out work that would be beneficial and which might be included in a program, thus furthering the preparation of a more complete program which would not be disrupted by these details coming to light after the work is under way. In addition, this practice may lead to a considerable reduction in correspondence. A natural sequence of this is the development of a more cooperative and better feeling between those whose duty it is to make the best use of a structure and those who must keep it in good condition.

A representative of the fire prevention department should be of great help in building inspection

work by pointing out desirable fire prevention needs, which, if incorporated with the work programmed, can be done most economically.

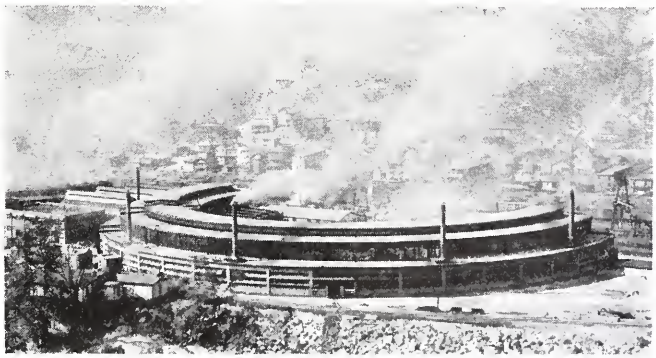
It is also essential that the inspection party be so constituted as to be able to make a relatively accurate estimate of costs on the ground, at least for the less complicated jobs. This is highly important, since there is little use in preparing an extended program, only to find that it must be curtailed materially to come within the budget.

The inclusion in the inspection party of the carpenter foreman who is familiar with the supervisor's ideas and methods, and who will eventually do the work, will be found to be of assistance in the making of these estimates. This foreman will not only do the work and spend the money, but must also be familiar with the work planned, and the better picture he has of the program the more economically he can handle it. Also, and not least, his presence will result in a highly desirable curtailment of letter writing.

While local conditions may be a factor in determining the best time for such inspections, it would appear that the autumn is probably better than any other season since all of the details may then be fully developed prior to the starting of the work in the spring. But more important than the time is the fact that the inspection should be carried out whenever possible as a continuous program. If this scheme is followed, the inspection can be speeded up through developing a familiarity with the methods, whereas an interrupted program requires the picking up of loose ends, and the ability to speed the work must be acquired after each interruption.

Selecting Essential Work

Probably the most important sense to develop is that of seeing the essential items first—the ability to exclude the non-essentials and see only those that are necessary to the continued useful life of the structure in all that this implies. This is not always as simple or easy as it would seem, for it may be possible that after the absolute fundamentals are taken care of, the remaining work to be performed will vary widely as to importance. This can best be illustrated by a comparison of buildings of widely divergent uses, such as an engine house and a station building in any good community. In the first structure, a sound foundation and engine pits in good repair are of primary importance, followed closely by consideration of the roof struc-



In the Case of Engine Terminal Buildings, It Is the Basic Structural Features, Not Appearance, That Require Detailed Inspection

ture, the walls, smoke jacks, roofing, siding, sash and doors in approximately that order, with the general appearance of the building a bad last. Such a building is purely utilitarian and not for beauty.

A station building, however, after its basic structural condition is taken care of, must be considered from the standpoint of appearance; civic pride enters into the picture and appearance is of great importance. A phase of the problem that must be given great thought in this case is that of safety for the public, people being notoriously careless. A step in the wrong place or of the wrong height, a loose or damaged floor board, a slivered settee, a door swung the wrong way, or any one of innumerable other small details may be the cause of accidental injury to person or property, leading to recovery for damage and adverse publicity.

In the same way that bridges and trestles have certain fundamental members which must be sound to make them safe, buildings have fundamental parts which should be inspected and examined first. Various portions of a building vary in importance and your committee has listed them in what it believes to be their order of importance.

Foundations

Regardless of what else is done to a building, if the foundation is bad, the building itself is still bad; no matter how much work is done above the grade line, it cannot prevent destruction of the building before fulfillment of its life expectancy.

If the foundation is of untreated wood, consideration should be given to replacing it with permanent material; if the structure is not worth the cost thus involved, the use of creosoted timber should be considered. This is particularly true in those areas where termites are a problem for it is only through careful inspection that this cause of destruction can be discovered, and the necessary steps must be taken for its correction as soon as possible.

Roofing

A leaking roof is bad, not only because of the possibility of damage to the contents of the building, but also because of the fact that if even a small amount of water finds its way into a building, it starts destruction which is insidious in that while it is not immediately apparent, it eventually causes serious failure of the structural parts to develop with some degree of suddenness. In buildings with finished interiors, costly damage is done to paint, plaster, furniture, etc., before failure occurs. The inspection of a roof should always include the careful examination of flashings, gutters, leader pipes and leader heads, since leaks in an otherwise fairly good roof will occur first at these critical points.

Floors

From the standpoint of safety to persons, flooring is highly important and its maintenance should be kept up most carefully. A loose, slivered or badly worn wooden floor; a spalled concrete floor; or an uneven asphalt, wood block or brick floor, is sure to claim its victims in personal injuries, while the necessity for caution by workmen to avoid accidental injury will slow down their work and lead to increased costs for their operations. Increased costs for trucking and claims for damage to goods which cannot stand rough handling are certain to result from operation over poor floors.

The inspection of floors of wood construction should extend to their

substructure and foundations, since the best of surface materials cannot long remain satisfactory on a springy support. The hiding of a bad condition by the application of a new surface is not maintenance. Consideration should be given to changing out wood floors at grade to concrete or some other form of permanent material.

Frame of Structure

In a building of honest design and construction, failure of structural parts may sometimes be attributable to lack of maintenance of other members or details over a number of years. A poor foundation overstresses these members; a leaking roof admits water to structural joints, with consequent rot and rust; lack of paint permits the rusting of nails, bolts, rods and other metal parts. Therefore, an inspection should include a check not alone of the main members, but also of joints and fastenings.

In buildings subjected to smoke or gas conditions, metalwork should be rigidly inspected, particularly the roof structure where spans are relatively large. Long neglect of roof trusses not infrequently results in sudden failure, which usually occurs at the most inopportune time, such as at the height of the heaviest snowstorm of the year.

Plumbing and Heating

The necessity for repairs to plumbing usually advertises itself, insofar as the visible parts are concerned and they are, therefore, usually well taken care of, not accumulating for any appreciable length of time. An inspection should, however, trace main lines through the building as failures frequently start with small leaks that become noticeable considerably in advance of major breaks.

Heating systems are probably inspected best in the spring when repairs can be made in an orderly unhurried manner and not left until a sudden unseasonable cold spell finds the plant out of service and, possibly, with some vitally needed part unavailable on short notice.

Millwork, Sash, Doors, Trim, etc.

These items, while apparently of minor importance, are actually among the major items of cost in some types of buildings. They are often neglected and owing to their inherent fragility, are the first parts to suffer from normal use and from deferred painting. Failures from the latter cause, once started, are progressive and no amount of later surface protection can prevent accelerated disintegration.

The question of a change in materials should be carefully weighed. Frequently, economies can be effected by replacing inferior materials with better materials, as for example, the substitution of treated wood for untreated wood; steel sash for wood; thicker glass, or where vibration or other conditions of service make it desirable, wire glass for plain glass.

In buildings having roof overhangs of wood construction, the millwork, gutters, etc., must be watched carefully to avoid allowing defects to lead to the destruction of the interior framing. Also, light, loose sash, missing glass, and doors not quite tight, result in enormous heat losses, with consequent inadequately heated areas or a marked increase in the consumption of steam or other costly heating mediums.

Exterior Walls

Exterior walls, when constructed of any of the various forms of masonry, are usually long-lived, but even so, they may be subject to defects or failure which, if neglected, can materially reduce the life of a structure. Brick walls, particularly of older buildings, constructed before the present cement-tempered mortars were used, sometimes show disintegration of mortar joints and pointing them up with a strong, cement-tempered mortar will result in longer life. When this condition, together with any considerable number of "salmon" or otherwise poor quality brick are found together, the problem is difficult of solution. In some cases it has been found economical to "gunite" the surface.

The joints in stonework are subject to the same defects and can be treated similarly. Generally, stone does not display the weaknesses of bricks, but occasionally individual stones develop defects which can be corrected individually by their replacement or by surfacing with cement mortar.

Concrete, unless composed of poor materials, is not subject to serious defects or disintegration, but when this does occur, a careful inspection must be made to insure the removal of defective materials and to so seal the surface as to prevent penetration of water, which otherwise will result in the destruction of the reinforcement.

Metal sheathing is at best an impermanent material and the only hope of its lasting for any length of time is to keep it well coated with paint. Unfortunately, it is often used on buildings where smoke or gas conditions are severe, and unless it can be protected on both surfaces, it will rust out just as quickly from within as without. It is necessary that fastenings be examined carefully to insure that the sheets are secured in place. There are few things more dangerous than a sheet of corrugated steel which is loosened by a high wind and sent sailing through the air. Wood can be protected only by paint, and the lack of it in time results in rusting nails and loose pieces of timber. Where the painting is long deferred, examination should be made to disclose where renailing is required.

Painting

Unfortunately, the first thought with regard to paint is that it is a material used primarily for appearance. However, this is not the case, as it is the one construction material that, for each dollar of cost, gives a dollar's worth of appearance and a dollar's worth of what is more important, protection of the material to

In the Case of Passenger Stations, Large and Small, The Element of Appearance Must Be Taken Into Consideration

which it is applied. Paint is often the last thing thought of in the preparation of a budget and the first thing eliminated when circumstances require curtailment.

In the development of the maintenance program, painting should be approached in the most keenly analytical manner. We all like to see our buildings spick and span and at all times shining with new coats of paint, and it is not very difficult to convince ourselves that painting is a necessity. However, except in cases affecting public relations, the decision to paint or not to paint must be based upon judgment of the physical rather than the aesthetic values. Paint should be applied to utilitarian buildings for structural reasons only and then only to the parts where it is really necessary to preserve the structural materials.

Parts should be painted when repairs are made and not await the entire repainting of the structure, since the forces of destruction may get started in the interim. It is not uncommon to see a fine maintenance program for painting curtailed over night, which may leave a considerable amount of new material unprotected for an indefinite time.

Factors in Recommendations

It is not the purpose of this discussion to detail all of the points which should be examined in forming a maintenance program; neither will all agree as to the relative weight of the several materials that should be used. Actually, varying geographical locations will, in large measure, determine this latter matter, since the most desirable materials to be used differ greatly in various parts of the continent.

Recommendations for the work required must be based upon various factors other than materials and your committee recommends the following order:

(1) Safety—There is no question but that this should be the first consideration.

(2) Protection of structural parts.

(3) Efficiency—This may include better lighting, either by increasing the number of light outlets, painting in light reflective colors, replacing a rough floor with a smooth surface, etc. In many instances savings in operating costs will offset the cost of doing this type of work.

(4) Protection of Contents—This is of importance in freight houses, station buildings, etc., where exposure to the weather may result in damage to the contents and claims from patrons for such damage.

(5) Appearance and Comfort—These are most important in structures where the public is involved, such as station or other semi-public buildings, and to a lesser degree in other types of buildings.

Another consideration is that of preference; that is, should the better and more permanent types of structures be given first consideration, to the possible detriment of the poorer or less permanent types, regardless of the use of the building? It is believed that the affirmative is the answer generally, particularly if there is any chance of replacement of the faulty or obsolete structure within a reasonable length of time or before the value of repairs is used up.

Timing is an important factor in the orderly carrying out of the work and in the laying out of a program, and it should be given consideration. Obviously certain classes of work can best be performed during certain seasons and the program should be laid out with this in mind. Since climatic conditions vary so widely, no set rule will apply universally and the plan must, therefore, be devel-

oped through a knowledge of climatic conditions in the areas in which the work is to be performed.

The Record

An orderly record can best be kept on a form that has been well thought out and developed by usage. This will tend to uniformity in character, regardless of who does the actual inspection and the clerical work, and will assure that every important item has been considered. The form should be uniform for the entire railroad in order that records from all divisions, when assembled for the use of general officers and others, will present the information in logical order and not haphazardly, as is the case when notes are jotted down in a note book.

The forms should then be easily subdivided under various heads, such as use, type of construction, extent of requirements, urgency of needed repairs, etc., or reshuffled in accordance with the dictates of the complete program or to develop statistical data in connection with its preparation.

One of the greatest helps for the formulation of the program is the data developed in prior detailed inspections that have been made carefully and unhurriedly at regular intervals and properly recorded. When so recorded, any necessary change in the program, either of extension or reduction, can be decided upon quickly, since the necessary data are at hand in readily available form.

In a majority of the cases, the extent of the work to be done is small, and in such cases the estimate of cost can be developed at the site. However, where heavy repairs are required, estimates should be developed in the office of the bridge and building supervisor.

It not infrequently occurs that economies or improvements can be effected by a considerable change in the plan of a structure when very heavy repairs become necessary. Such problems should be developed in conjunction with the engineering forces and the department affected.

Obsolescence a Factor

Finally, the necessity during the last few years of keeping new construction to an irreduceable minimum, has naturally resulted in the retention of many obsolete buildings which normally would have been replaced. This, in turn, would be expected to lead to greater costs of maintenance, but these also have had to be reduced. Therefore, it is absolutely essential that those upon whom rests the responsibility of making the recommendations for maintenance, shall have a sense of values, ingenuity, and the ability to weigh and balance raised to the N-th power, to the end that the buildings of the railroad shall continue to function.

DISCUSSION

President Bechtelheimer: Mr. Peyser, I am sure this report covers the subject thoroughly. Nothing appears to have been overlooked. It could well be designated as a manual for building inspection and will be invaluable to all those responsible for the inspection of buildings.

C. M. Burpee (Railway Engineering and Maintenance Cyclopedia): Mr. President, the committee is to be commended on the way in which it has developed the sub-

ject and the information which it has gathered; also on the manner in which it has presented its report. The report is particularly valuable because it comes at a time of increased earnings, that undoubtedly will be the forerunner of increased building maintenance programs during the coming year.

It seems to me that the outlining of the supervisor's responsibilities, the detailed outline of inspection, stressing the most essential work, are well expressed, with many timely comments. The rating of the various factors upon which repair recommendations should be based is also valuable.

The report as a whole, in my opinion, presents the subject in a very orderly manner. Used as a guide in the formulation of a maintenance program for buildings, it presents a reasonable, efficient and economical method of carrying out the preliminary phases of the work. If it is followed, it will insure a maintenance program which precludes the possibility of extensive repairs being carried out a few months prior to the razing of a building; or, on the other hand, the injudicious neglect of railway property.

H. B. Christianson (C. M. St. P. & P.): I echo Mr. Burpee's sentiments about the excellence of the report, although I think there are a few matters of plan on which there might be some difference of opinion. Most of the buildings on a division are used intensively. I don't think there is any building that does not require an annual inspection. I think the report states that some might be inspected every three years.

With reference to the co-operation of other officers on the railroad, I believe the position of the committee is very well taken. On our division, we have the master mechanic, the car foreman, and all of the other interested division officers present at some time during our inspections. We can't have them with us all of the period because of the time it requires to make a detailed inspection.

I think there is one thing of importance the inspectors can initiate, and that is recommendations for the retirement of buildings; there are so many buildings that have been found unnecessary during the last few years. We have found many structures that are not being used, and when a study of them has been made, we have found that they could be taken down or, at least, reduced in size.

G. S. Crites (B. & O.): I have expressed the opinion in conventions at various times that our younger members must have some thoughts they would like to express. My feeling is that a report of this kind belongs to the committee until it is presented. After it is presented, it belongs to the American Railway Bridge and Building Association, and I think our younger members should get up on the floor if they have anything to say. It is not the idea that we should have a prolonged discussion on this subject, but it is a very weighty problem at the present time and I am sure that it would be of interest to the convention if some of the younger members would express their thoughts on the subject.

L. D. Garis (C. & N. W.): It seems to me that there is some relation between bridges and buildings. I have never done any building inspection, but I have inspected

bridges for the last 13 years. Sometimes I don't know where a bridge ends and a building begins.

Certainly gases and fumes around large stations cause damage to steel that should be taken care of by repairs and paint. Another thing I have encountered is corrosion around the bottoms of steel columns where there is generally an accumulation of moisture and dirt. We have corrected conditions of this nature on the Chicago terminal with paint.

W. A. Sweet (A. T. & S. F.): I am particularly interested in that portion of the report referring to exterior walls which states that in some cases it may be economical to replace old portions with new. In this connection, we have given some thought to the covering of old buildings with asbestos shingles, of which there are several varieties on the market. I am wondering if any of you have had any experience with covering a station building with asbestos shingles.

Chairman Peyser: I have been interested in some buildings that have been modernized by the use of asbestos shingles. You will find that this material is not only good over a wood structure, but that it also makes a good appearance. It cannot be classed as an absolutely permanent material. You are not replacing a building, you are resurfacing it, and asbestos shingles form a good covering. However, asbestos will absorb moisture and dirt. That can be prevented by a coat of oil to make the material impervious. Some have even gone to the extent of using an oil stain over asbestos shingles for color and the improved appearance that it gives. It is not a cheap material. On the West Coast, the cost nearly equals that of stucco.

F. R. Spofford (B. & M.): We have made some use of asbestos siding on both new structures and in the modernization of old ones. Where this material is used, we have found that careful consideration must be given to the character of the trucking about the building and to the possibility of malicious destruction. Where it is anticipated there will be a considerable amount of trucking or malicious destruction by vandals, our experience would indicate it impractical to cover the lower part of the building with such material. Asbestos shingles on first examination appear to be hard enough to resist a reasonable amount of mechanical wear, but our experience shows that they become damaged by express and baggage trucks. We have also had to make replacements due to damage done by boys.

W. A. Hutcheson (C. & O.): Mention is made in the report of the replacement of lime mortar with the newer type of cement-tempered mortar. In recent new construction on our road we have had considerable difficulty with walls that were built with this cement-tempered mortar, because of its absorbing moisture. This has caused some damage to the interior of the buildings.

I refer to this because some one else might have had a similar experience, and would be willing to tell us what his road is doing about it; or just what can be done about it.

President Bechtelheimer: I do not know the answer to Mr. Hutcheson's question, but there must be somebody here who does.

Mr. Sweet: In speaking of cement-tempered mortar, do you refer to some of these newer products containing a non-shrink material, or just regular mortar containing Portland cement?

Mr. Hutcheson: The particular ones that I have in mind are the patented mortars, which I understand contain a considerable amount of cement and are practically a cement-tempered mortar.

Chairman Peyser: I have not had any experience with these new materials you speak of. So far as the seepage of water through a building is concerned. I think that, possibly, in a rough, utilitarian type of structure, the amount of leakage would not be great. On a finished structure, however, such as an office building, with a finished interior, we would not consider placing a finishing material directly against the brick without the use of furring. We prefer the use of lath and plaster over furring for the reason that the air space thus created between the wall proper and the interior finishing material tends to minimize any moisture which might pass through the wall from the exterior.

It would be interesting to hear something more about the use of these special materials. We do know that cement-tempered mortars shrink, but I think the worst offender is the lack of moisture in the bricks. We are very insistent that bricks be kept well wetted up to the time they go into the wall. They are soaked over night and are kept wet until they are laid into the wall. By equalizing, as nearly as possible, the moisture content in the bricks and the mortar the setting of the mortar is retarded sufficiently to minimize shrinkage.

R. W. Johnson (C. M. St. P. & P.): Mention is made that probably the best time to inspect buildings is in the autumn. I think many roads have to inspect their buildings in the spring because they have to know by the first of the year what they are going to need the following year. The spring inspection indicates what will be done and gives sufficient time to develop plans for the following year.

President Bechtelheimer: That seems like a good idea. Each road, no doubt, works that out to suit its particular conditions.

K. L. Miner (N. Y. C.): I was impressed with that part of the report under the heading of "Painting," where it states that you get two for one. That is a thought that should go beyond this convention and this association, to the managements of the railroads.

Mention is made that when you put a dollar's worth of appearance into a building, you also get a dollar's worth of protection and preservation of the building. It is my experience that management usually feels that painting is for appearance alone. If management could realize that we get protection and preservation as well as appearance, I believe it would be well worth while. When painting a building we should certainly make repairs. Often, when we cannot paint, we defer making repairs because of the unsightly appearance that would result. I believe that painting is a valuable and important part of building maintenance.

President Bechtelheimer: It seems that the two for one idea should be given greater emphasis when urging increased painting.

E. C. Neville (C. N. R.): Mr.

President, this is a well-prepared report. I think that we should all follow the principles which it sets forth. In one place, it mentions that we should make sure that the foundations of our buildings are sound before we make any general repairs. In my territory, we have many buildings that need repairs and, from a casual inspection, one might think that all that is necessary is to make surface repairs or changes. On closer inspection, however, in nearly every case, we find that the sills or some other parts of the foundation are gone.

I had a case of that kind recently. The repair of the building itself, that is, the interior around the doors and windows, etc., did not amount to much, but the building was set down on the ground, and when I did a little "groundhogging" and got underneath, I found that I could dig the sills out with my hands; so, it developed into a fairly sizable job. That is one feature of building inspection that I think we should pay particular attention to before entering into any minor reconstruction.

G. E. Boyd (Railway Engineering and Maintenance): What Mr. Neville has just said brings up one point that I think should be emphasized—a point that was mentioned in the report, but likely to be overlooked. That is, that the inspection should be unhurried. Too many inspections are casual. I don't mean that the inspector should loaf on the job, but an unhurried inspection is likely to turn up a good many points that the casual inspection will miss.

President Bechtelheimer: There is certainly no question but that if an inspection is made at all, it should be thorough. Mr. Peyser and Mr. Varker, I think the association can point with pride to your report and say "well done." I discharge the committee, feeling that no group could have done a better job.

The Heating of Locomotive Terminal and Shop Buildings

Report of Committee

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I. A. Moore
Chairman

This report deals with the heating of railroad terminals which have locomotive erecting shops, boiler and machine shops, blacksmith and car repair shops, enginehouses, and other terminals and shop buildings served by a central power plant, where boilers in the power plant supply steam for generating electricity, operating air compressors and steam pumps, and furnish high pressure steam to the various shops for power purposes. Under these conditions, it is obvious that the central power plant should also act as a central heating plant, for practically all of the exhaust steam from the generating equipment, air compressors, and steam pumps can be used for heating purposes.

Design

Each part of the entire heating system, from the central plant to the smallest local unit, must be designed for its purpose, and be properly equipped with valves, traps, vents, expansion joints, and other specialties, to secure a proper and balanced installation. In new buildings, the design and construction should aim at the minimum heat loss consistent with reasonable cost, comparing the overall cost of insulation with the savings in fuel under average conditions. Only a fair consideration of all factors, including both the physical condition of the building and the type of heating installation to be used, can determine an economical and properly designed heating system.

In modernizing old installations, consideration should first be given to the building, to eliminate all heat losses possible, and then to a study of the existing heating system. It may require a complete re-design, or may be corrected in part only, such as relocating the actual heating elements, changing size, type, or capacity, etc. Special care should be given to main supply and return lines, and all sags, bends, or air-blocks removed; also, valves and traps may be faulty or may need renewal. The question of the extent of the modernization to be done depends on the probable remaining life and the value and importance of the building to the railroad.

Piping

Pipe installations may be of genuine wrought iron or black steel pipe, depending upon the condition existing at the location under consideration. Wrought iron pipe is preferable where gases and moisture are present to cause serious maintenance problems due to corrosion of the pipe. This difficulty is encountered in enginehouses. Steel pipe is satisfactory for many heating installations, especially in buildings where very little corrosive action from gasses or moisture is expected.

Welded connections should be used for all pipe lines where pipe two inch and larger is being installed. Welded connections have many advantages over flanged or screw-type connections, some of which are (a) lower cost for labor and material, particularly in the larger sizes; (b) lower maintenance cost; (c) much neater finished job; and (d) additional connections can be installed in existing lines with little or no disturbance to the line.

It is considered good practice to construct a pipe tunnel from the central power plant to the various buildings to be heated. This tunnel should be constructed of concrete and of sufficient size to permit ample working space for maintaining the various pipe lines. A reasonable size is six feet high by four or five feet wide. Liberal sized manholes should be provided at approximately 200 or 300-ft. intervals for access to the tunnel and particularly for ventilation for workmen when making repairs to pipe lines therein. It is essential that proper drainage be provided for these pipe tunnels.

Such tunnels may not only house steam pipes, but air, hot and cold water, gas, oil, and other supply lines as well. These pipe lines should be arranged in such a manner that they can be inspected and repaired readily. Although the heat loss in steam piping in such a tunnel is of little consequence, it is advisable that these pipe lines be insulated.

Overhead and Inside Piping

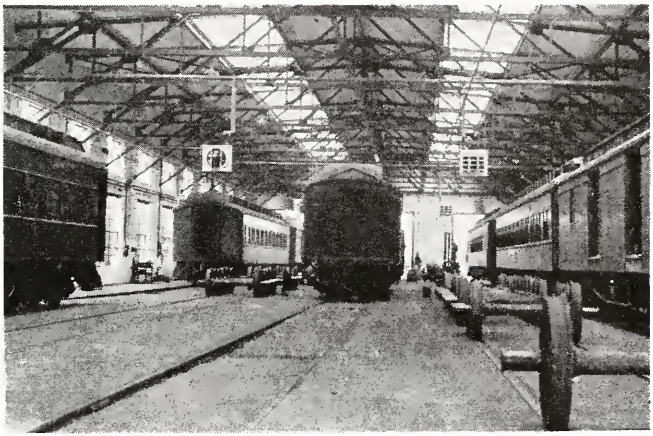
An overhead pipe line for the transmition of steam can be constructed at a much lower cost than a tunnel installation; however, better insulation must be provided, together with a weather-proof jacket over the insulation. Furthermore, the maintenance cost of an overhead pipe line is much greater than for similar pipe lines in tunnels.

There is also the necessity for providing pipe lines for returning the condensation to the boiler, and this is usually accomplished by providing an underground return line, laid in an insulated conduit. Of course, the condensate can always be wasted in an adjacent sewer, but this is not good practice. An overhead steam pipe line is justified where no other piping service is required—that is, for heating purposes only.

Steam heating pipe lines should be taken out of the pipe tunnel adjacent to buildings and continued through the buildings in exposed locations. They may be placed overhead, or around the building walls. In some cases they are insulated; in other cases not. When not insulated, the assumption is that any loss tends to heat the building being served. If the supply of exhaust steam should be insufficient for the buildings so served, high pressure steam may be admitted to the heating main through a pressure-reducing valve at the building site—assuming that the high pressure steam lines are also carried in the pipe tunnel.

Before the advent of cast iron radiation it was the practice to install pipe coil radiation. This type of radiation was simple to install and main-

tain, with no worry about high or low pressure steam, and usually high pressure steam was furnished. In many instances, it seems as though radiation was installed without regard to the amount necessary to heat the building properly. It was the accepted practice at that time to place heating coils under all windows and adjacent to, or under, skylights.



Unit Heaters of Various Types Have Been Used Effectively in Shops and Other Terminal Buildings

In the older types of engine houses, heating coils were placed in the engine pits. In this location, the heat from the coils will remove the ice and snow from the underside of locomotives. However, heating coils in engine pits constitute a hazard to men working in the pits and around the engines, while the water from melting snow and ice, dripping on the coils in the pits, adds to the vapor and fog already in the house.

Blast Heating

Hot air, or blast, heating is a vast improvement over the pipe coil, or radiation system of heating, especially in engine houses. The blast heating system consists of banks of cast iron radiators or pipe coils; a motor- or steam-driven ventilating fan; and a duct system for carrying the heated air to the various parts of the building to be heated.

This equipment is usually housed in an annex to the building to be heated. The heating coils are placed adjacent to an outside opening provided with louvres to keep out rain or snow; the outside air is drawn through the heated coils and forced through the duct system by the ventilating fan.

The duct system may be overhead or underground, and decreases in size from the heater room to the extremities of the building. The underground duct system, usually constructed of concrete with laterals of sewer tiles, is rather costly but requires little, if any, maintenance. The overhead duct system is usually constructed of metal pipe and costs less than the underground system, but the maintenance is high; often it is difficult to provide a suitable location for such ducts. An overhead duct system in an enginehouse has a very short life on account of the corrosive gases present.

Some installations in enginehouses are so constructed that the air is recirculated. This reduces the amount

of steam supplied to the heater coils very materially. It is not the best practice but produces very good results. The heating of enginehouses with hot air is very desirable, as considerable moisture in the air is absorbed by the circulating hot air.

Unit Heaters

The advent of unit heaters marked an advance in methods of heating, not only providing better distribution of heat, but also effecting a decided reduction in the cost of heating.

There are three main types of unit heaters—projection, propeller and blower. In the projection type, the motor shaft is set in a vertical position; the fan and heating elements are located directly below the motor, and the heated air is directed downward, covering a circular area. In the propeller type, the motor shaft is set in a horizontal position with fan and heating elements in a vertical position; the air is directed downward at an angle towards the floor where it is deflected in all directions. The blower type is a much larger heater, with the motor set in a horizontal position, driving a shaft to which rotating fans are attached, with the heating elements in the fan housing. Various openings are provided in the fan housing where ducts can be attached. Such heaters can be located on the floor, or suspended from overhead.

Each type of unit heater has its particular use. However, the usual type is the propeller unit heater. It is the accepted practice to suspend such heaters from the roof supports, from the columns, or somewhere near the outside walls, depending upon the type of structure to be heated and the best location of the heaters for supplying heat where it is most needed.

Most heaters are supplied with copper cores, which compose the heating element. There are heaters on the market which have cast iron cores, and others with steel pipe cores to which fins are attached. Heaters can be furnished for either high or low pressure steam.

Unit heater installations require much less piping, fittings and valves than a comparable amount of cast iron or pipe coil radiators, based on the heat output of each facility. They occupy much less space, and in a suspended position require no floor space.

It is preferable, in most instances, to provide heaters with low outlet temperatures and large capacities, the reason being that less velocity is required to force the heated air to the breathing zone, and lower temperature air will not rise as rapidly as that of higher temperature.

Thermostatic Controls

Unit heaters can be fitted with thermostatic controls, which provide means for effecting economies in steam consumption. However, it is the practice to provide push-button control for each heater. With such controls, only those units that are required need be placed in operation. Unit heaters may be operated in the summer months for circulating air.

Heaters with cast iron cores should be used in enginehouse installations because of the corrosive action on heaters with copper cores. They should be placed about 12 to 14 ft. above the floor line and a short distance from the rear wall, between alternate stalls. The heated air is directed downward and towards the entrance doors. Some railroads place heaters in engine pits to expedite the removal of ice and snow from the underframes of locomotives.

In other shop buildings, heaters should also be placed 12 to 14 ft. above the floor line. If possible, the locations should be such as to provide a circular motion for all of the

air in the building, and yet be directed primarily towards the windows and door openings. It is essential that proper pipe sizes be provided, and that steam traps be of ample size.

Heat Losses

A careful study of the heat losses in the buildings under consideration will usually disclose many opportunities for eliminating, or reducing, a large proportion of these losses. In general, ordinary shop buildings present little opportunity for thermal insulation, except the roof areas.

All buildings can be made reasonably tight by continuous putty and glazing repairs, caulking around doors and windows, and providing storm sash where practicable. Sash-operating devices for steel sash windows should be inspected each season and repairs and adjustments made where found necessary. In some instances, windows may be removed and the openings thus formed be filled with glass blocks, thus eliminating maintenance and reducing the heat loss to some extent.

Careful study should be given to ventilation in certain buildings such as blacksmith shops and paint shops, where building codes require a definite number of air changes per hour to carry off obnoxious gases. Heat losses are severe in such buildings, especially where spray painting is being done. Close cooperation with the foreman in charge should be secured to see that exhaust fans are operated only as needed.

Conclusions

Heating installations of any magnitude should be developed from studies made by competent engineers. Heat losses in buildings, the amount and proper location of heating units, proper pipe sizes, expansion joints, are all matters of design.

The main supply lines should be thoroughly insulated, and where exposed to the action of the weather, waterproof covering must be provided to protect the insulation. Welded joints are preferable to screwed or flanged connections for pipe sizes of two-inch diameter and over.

In the replacement of pipe coil radiation, careful consideration should be given to the use of unit heaters from the standpoints of low first cost and efficiency of operation.

The primary purpose of a heating system is to maintain temperatures that will permit the men to work in comfort; failure in this causes loss of time and efficiency.

DISCUSSION

President Bechtelheimer: Members of this committee, I feel that you have covered the fundamental features of the subject of heating locomotive terminal and shop buildings. The report is concise, yet complete. You have given the framework, which can now be filled in more completely by a worth while discussion. The report is open for discussion.

L. E. Peyser (S. P.): You apparently referred to steam heating exclusively in the report and did not give consideration to gas heating. While, of course, which is used is a regional matter, there are parts of this country where natural gas is available at low cost and should be considered. That happens to be the case in my territory. We find that we can burn gas in a unit heater to advantage and distribute the heat properly.

In fact, most of our power plants in California are operated by gas rather than by coal or oil, although the boilers are usually set up so as to be convertible very quickly—within an hour, I believe—from gas- to oil-burning.

In heating, we find it much cheaper to put in gas unit heaters. We use them in shops, in stations, and in all other types of buildings. It is a gas-burning unit heater, with a fan behind it. We can distribute heat through buildings better with these direct gas heaters than we can by using a gas-fired boiler, and supplying steam to the various heaters necessary. The gas-burning units are less expensive in first cost, and cost much less to install than the steam-consuming unit heaters.

Chairman Moore: I don't believe the committee gave consideration to gas because, probably, with the exception of California and in other warm climates, gas isn't readily available.

Mr. Peyser: Natural gas may not be available in some regions, but in California, parts of Texas, and in certain other states, there is an abundance of such gas—in fact, a super-abundance. They find it hard to get rid of.

President Bechtelheimer: I think, possibly, if Mr. Peyser lived in this part of the country and heated his house with gas, he would readily realize why we don't use gas in some of our railway heating units.

Mr Peyser: In my residence in California, I used to burn coal in my furnace. We don't burn much coal in California because we have an excellent climatic condition. Futhermore, coal is expensive there. I stopped using coal several years ago, just as soon as we got natural gas; put in an over-size furnace, and found that the cost of heating my house the first month was about $3.00 less than the cost of the one ton of coal that I would have used in that month ordinarily. I am speaking of our first cold month, which is January.

President Bechtelheimer: We have gas available, but it costs more money, and that is where we are handicapped.

Mr. Peyser: No doubt, but there are areas in this country where a lot of gas is used for heating, and I think that should be considered in the report, because we have found it flexible and inexpensive.

F. H. Soothill (I. C.): I would like to know if Mr. Peyser is referring to open-flame heaters.

Mr. Peyser: The heater that we use is a metal radiator. The flame is within the radiator and we exhaust the fumes through an inexpensive asbestos vent. The fan is behind the radiator. It is very much like the steam radiator except that it is open at the bottom and the flame is within the radiator.

Of course, I am not thoroughly familiar with methods of winter ventilation in these more severe climates. You know what they say about Boston: "When they want fresh air, they open the closet door."

L. C. Winkelhaus (C. & N. W.;) We have a gas installation in one of our buildings in Milwaukee, Wis. I have looked it over a couple of times, and it is very efficient. It may cost more, but it works well.

Mr. Soothill: We have a great many gas installations in the Chicago terminal. There are a number of factors to be considered in connection with the cost of heating, particularly under operating conditions in suburban territory. Coal

storage facilities are, of course, limited and, therefore, where we burn coal, we burn hard coal rather than soft coal. The labor in keeping heating plants going will enter into these considerations. In the final analysis, we find that it is cheaper, or as cheap, and a whole lot more satisfactory, to burn gas than coal. So, as I say, all of the factors must be taken into consideration.

Chairman Moore: From this discussion, I take it that for the most part gas would be a very fine thing for smaller installations, but you certainly would not use it to any great extent in a large terminal where you have a number of buildings. Possibly in a location in California, where gas is cheap, it might be usable, but in some of the larger terminals, the cost would appear to be prohibitive.

Mr. Soothill: I think that is true, because all of the large mechanical terminals have extensive power plant facilities which furnish heat for all of the buildings.

A. Chinn (Alton): I want to say first, that there is nothing like coming to a Bridge and Building Association meeting to learn things. I am interested in anything that may effect a reduction in the cost of any part of my railroad. I note in the report under Unit Heaters, the statement that: "The advent of unit heaters marked an advance in methods of heating, not only providing better distribution of heat, but also effecting a decided reduction in the cost of heating."

I would like to inquire of the committee whether it has anything definite that would show that unit heaters could be installed in place of cast iron radiators and effect a saving that would more than pay for the cost of installing them. Would you say the saving would be sufficient to justify the expenditure of replacing the old type heaters with unit heaters?

Chairman Moore: I don't think the committee can present any definite costs on the subject of using unit heaters for radiation in place of cast iron radiators.

Mr. Chinn: I suppose the reduction you have in mind would be due to a greater efficiency in the use of steam with the unit heaters. In other words, there would not be as large a loss in B.T.U.'s between the burning of the coal and the distribution of the heat in a building by means of unit heaters.

We haven't any unit heaters on our railroad, but I have been in buildings where such heaters were in use, and have always been surprised, and sometimes amazed, at the tremendous amount of heat that can be put out by a very small unit. It just occurred to me that maybe you could get the required heat with unit heaters from a very much smaller amount of coal.

Mr. Peyser: I might cast a sidelight on that. In the old days when they put in pipe coils, everybody stuck in another piece of pipe and it became very inefficient. Some spots were overheated and some underheated. By the application of unit heaters you direct the heat to the exact spot to be heated. Further, pipe radiation, or any other type of heat radiation, is less efficient than a blower. Where we use blowers, we use high-pressure steam, and they are equipped with deflectors that are two-dimensional. That is, we can direct the heat downward or upward, and to a varying degree to either side, and in any amount. If we want more heat on one side than on the other,

the direction of the deflectors can be so arranged. So it is a matter of turning the heat directly where you want it, and not allowing it to rise before it comes to the point where it is needed.

Mr. Chinn: I think many of you, like I, have noted that in station buildings where there are high ceilings and wall radiators, the upper air is very warm, while people at the waiting room level are cold. In some cases we have sealed off the ceilings to keep the heat down where it will do some good.

Chairman Moore: Speaking of the reduced cost that you were discussing, Mr. Chinn, I think that the ordinary pipe-coil radiators are put under windows and in miscellaneous places where they are very ineffective. I have seen them around skylights, where they are of no use at all.

There is no question but that considerable steam saving can be effected by the use of unit heaters located properly. Also, you can control them with a thermostat. You can't control an ordinary radiator because nobody ever shuts it off. The same is true of an ordinary pipe coil. They are on continuously. During the night, when we don't need much heat, we can control the unit heater installations by means of thermostats. One certainly can't control the ordinary pipe system that is found in roundhouses and other places. That was where we felt that considerable saving could be effected in heat control.

Another thing: on week ends, you can reduce the temperature in shops materially, as low as, say, 50 deg.—and some buildings are not used at all during these periods.

Mr. Chinn: It would seem to me from what you say and from what I hear about these unit heaters that maybe they ought to pay for themselves in the smaller consumption of steam. I would be interested to know if anybody has worked up a comparison of costs between coil radiators, cast iron radiators and unit heaters.

W. A. Sweet (A. T. & S. F.): We have a number of installations of unit heaters in my territory. We installed them in a roundhouse a number of years ago. I notice the committee calls attention to the fact that unit heaters should be directed towards the windows rather than hung on the outside wall, blowing in. We made that mistake in some of our early installations. If there are doors or large windows, the heaters should be back from the walls blowing toward them rather than into the building where the men work; otherwise they create a strong draft and circulate a lot of cold air with the warm. In later installations we have hung them differently and we get much better results. In installing these unit heaters, I think a new system of heating was necessary in both cases.

If you are confronted with the problem of renewing your heating systems, possibly some of the economies that have been mentioned by the committee should be considered; that is, rather than renew the old style, you should give consideration to unit heaters.

Mr. Chinn: In other words, you would not replace an old style heating system that is working as efficiently as it can, simply on the theory that you would make enough savings with the unit heaters to justify the change; you would wait until the old style system needed

renewal or repairs, and then, instead of repairing it, or renewing it in kind, you probably would go to the unit heaters.

Mr. Sweet: That is what we have done.

M. A. Higgins (C. & N. W.): In one of our large machine shops we checked the original plant and found that a pipe coil placed near the roof not only failed to heat the building but induced upward drafts that added to the heating problem. The correction of that condition will probably be removal, not replacement; a correction of the original installation through the use of unit heaters.

We have used unit heaters at Council Bluffs, Ia., and in our Chicago shops, and probably will go to them in the case of another large machine shop now under consideration. Unit heaters can be spotted scientifically and the pipe layout can be reduced so that a definite saving can be shown over the older systems of radiation.

T. D. McMahon (G. N.): The report covers in a general way the problem of heating shops and other terminal buildings. Heating shop buildings is not a great problem, but heating a roundhouse is. Originally, we had pipe coils. They rusted out; men broke them down using them for scaffolding. We went to cast iron radiation built in recesses in the walls, protected by the angles. The angles rusted out and the concrete scaled off. Then we went to the underground central blower system, which is fine.

On our road, the most northerly road in the United States, we are confronted with severe climatic conditions in winter. Engines come in covered with ice and snow. Heat applied underneath melts the ice and helps turn engines quicker, but as power got larger and roundhouses were extended, the air ducts proved too small and in the wrong locations. Sometimes we had to install two or three blower systems, but in later years we have been going to unit heaters.

The committee recommends a heater with a cast iron core. We had some with copper fins. They rusted out not only from sulphuric acid conditions in the roundhouse, but also from decomposed oxygen in the condensation. We have tried unit heaters with cast iron cores and aluminum fins, and have found them very satisfactory.

Right now we are building a 14-stall roundhouse, part of it 140 ft. long, and part 134 ft. long. The original house was heated with an underground blower system, but in this new installation we are going to use unit heaters. With unit heaters, the original cost is less than for either cast iron radiators or pipe coils. You can get more square feet of radiation out of a unit heater than you can out of a cast iron radiator or pipe coil; the labor cost of installation is cheaper and the maintenance is less, except for the rusting out of the unit heater casings. If they are placed in the proper locations you can direct heat where you want it. They don't save any fuel; they just get more heat out of the steam, and you get it where you want it.

With ordinary cast iron or pipe radiation, the heat naturally rises. The air in the house is stratified. Toward the top it is very hot; then, as it cools it descends, so that at about the breathing line it is probably comfortable, but you are wasting a lot of steam trying to heat space that you don't use.

The gentleman from California

spoke about using gas for unit heaters. I am just completing a structure in Montana where we have both gas and coal. We are putting in gas-burning unit heaters. We have to get an exhaust or vent pipe to them, of course. This is being done to save the cost of putting a steam heating plant in the basement and steam-heated unit heaters about the building. It is a building that will be occupied by a tenant, so the cost of the fuel won't make any direct difference to us.

We have used natural gas before in some small hot-water heating plants in depots and small buildings. We have quite a lot of gas in Montana. In many cases we burn oil in our heating plants. We have several installations that are using oil in stationary plants, and we also use pulverized coal. In addition we have used Dakota lignite, burning it on a grate. In heating shops or roundhouses, therefore, in addition to what is contained in the committee's report, you have to consider each case on its own merits. The report mentions putting pipes in conduits, but plants grow and often we find the conduit is in the wrong place.

Mr. Soothill: Does anyone have any information as to the cost of unit heater installations?

Mr. Higgins: We have not broken our costs down to a comparative basis. However, we have made a rough comparison of the overall cost of the old radiator type and the unit heater type, and the latter shows a substantial saving, not only in the comparative cost of unit heaters, but also due to simplification of pipe lines and valves and their coverings. The distribution system cuts down the cost, and the labor of installation is no problem.

Mr. Soothill: I think that partially answers Mr. Chinn's question. It seems to me that unit heaters are more flexible and lend themselves to a progressive job. They might not all be installed at one time. In other words, you might try them in a stall or two, and if they prove satisfactory, you can extend the installation.

Mr. Chinn: I am surprised to hear, though, that there is no saving in the amount of coal burned. It seemes to me that if you are using heat more efficiently, then you should require less heat.

Mr. McMahon: There probably is a little less coal consumed due to the more efficient use of the heat.

Mr. Chinn: But you don't think that amounts to much?

Mr. McMahon: No.

J. S. Vreeland (Ry. Engr. & Mtce.): I have studied the film theory of heat transmission, which indicates that where air that is being heated passes by coils or pipes at considerable speed, the efficiency of the heat transmission is increased. That means that you get more efficient heating. In addition, the unit heater places the heat where you need it most.

President Bechtelheimer: If there is no further discussion, I will discharge the committee with the thanks of the association.

The Adjustment of Locomotive Watering Facilities to Larger Tenders and High-Speed Trains

Report of Committee

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W. G. Powrie
Chairman

During the last 10 or 15 years, the railroads have been forced to provide faster and more dependable freight and passenger service to meet the competition of other forms of transportation. The effects of this have been felt in every department. One of the developments that has been necessary as the result of this speeding up of schedules, which has involved larger power, larger tenders and longer engine runs, has been the re-adjustment of locomotive watering facilities. This development has presented a variety of problems with which we must deal.

In general, the larger tenders and extended engine runs have required improvements or additions to facilities at some water stations to meet increased demand, and have left other wayside stations non-operative. The retirement of these latter stations should be undertaken only after giving them most careful study, because, in times of increased business or in cases of emergency, such as bad weather conditions or failure of the equipment at the regular water stations, these seemingly unimportant stations may become very important to the movement of trains.

In our discussion of the various problems covered in this report, no attempt will be made to establish definite rules or practices to be followed as there are but few instances where duplicate conditions can be found.

Storage Capacity

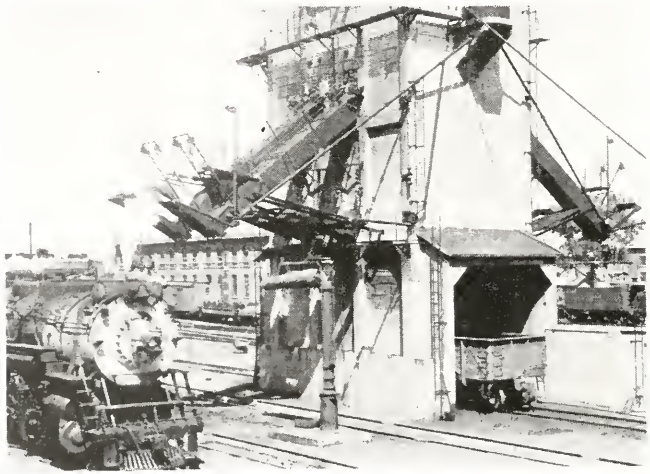
The advent of larger locomotive tenders and through engine runs have changed considerably the demands on locomotive water stations. This change in demands can be met either by changing the amount of storage capacity or by changing the rate of refilling storage tanks, or both. Many terminal storage tanks, which were considered adequate a few years ago, have been found entirely too small for the requirements now placed upon them. This has been brought about by the fact that the larger locomotive tenders now in use have eliminated the necessity for taking water at many

wayside stations and have thus thrown an increased load on the terminal facilities. In many instances, wayside stations have been found no longer necessary. Several roads have reported that from 20 to 25 per cent of their water stations have been retired within the last 20 years. At one time a mid-western road had 26 steel tanks, all in condition for use, but of little or no value in their present locations. Most of them have since been cut down and disposed of or re-erected elsewhere.

Study Shortages

The problem of increasing the available supply of water for locomotives at a water station is not always a matter of increasing the storage capacity. A careful study may develop that the storage facilities are ample but that the pumping equipment is too small or that some other factor is effecting a slow rate of delivery to the tank. One road reports that at one of its stations, which had a 50,000-gal. wood tank fed by gravity from a reservoir two miles away through one mile of 8-in. pipe and one mile of 6-in. pipe, they could not fill the requirements for water. There was an ample supply of water in the reservoir, but the tank and pipe line were too small to take care of the demand. A new 100,000-gal. tank was erected and the 6-in. supply line was replaced with 8-in. pipe. This still did not give them enough water during periods of increased business, although the total head on the tank was theoretically sufficient to overcome the friction in the supply pipe and to keep the tank full.

As a result of this situation, all features of the installation were checked and rechecked and it was finally decided to remove the float valve in the top of the tank and let the water flow continually. This was done because it was noticed that the flow to the tank was considerably less when the valve first opened than it was after the water had been running for a time. From that time on the road experienced no more water shortage trouble at this station. It was concluded that the continuous flow of water through the pipe line prevented the formation of air pockets which had been forming previously and had been cutting down the free



This Point on the Burlington at Creston, Ia., Provides for Coaling, Sanding, Pan Cleaning and Watering at the Same Time

flow from the reservoir to the tank. This experience is cited to show that oftentimes the facilities are adequate to meet the demand if they are in proper working order.

In other cases, however, it has been necessary to increase the storage capacity, especially where the natural water supply is limited. In these cases, pumps of low capacity must be used and must sometimes be operated 24 hours daily, pumping to large storage tanks in order to meet the demand.

Not only the total demand for water, but also the distribution of this demand is important in determining the proper size of facilities required at a water station. Where the demand is spread out evenly over the 24-hour period, the storage capacity and pumping equipment need not be as large and as costly as where the demand is concentrated within a few hours.

Expedited Delivery

The speeding up of both passenger and freight train schedules, with the subsequent shortening of stops, has emphasized the problem of proper design. The first changes that were necessitated by the larger tenders were the raising of the tank spouts and water columns. In the case of the tank spouts, this was often done by inserting a beveled wood washer in front of the outlet elbow, which flattened the slope of the outlet pipe and raised the spout end the required amount. In some cases, where this would not accomplish the desired raise and where the tank was in good condition, the entire tank and tower were raised.

The spouts of water columns were raised and otherwise adapted by inserting flanged spools in the upright columns and lengthening the operating rods by welding on extensions in the field. In many cases, the raising of water facilities to accommodate tenders 12 to 13 ft. high presented a problem when watering tenders with a manhole height of about 9 ft. This has been more pronounced with the rigid type of water columns than with tank spouts or water columns with telescopic spouts. This difficulty has been partly overcome by installing a hinged extension to the nose of the rigid spout, to be used when watering low tenders, and to be swung back when watering high tenders.

The next problem was to cut down the time required to take water. Delays due to extra stops for water can sometimes be eliminated by relocating present facilities, or by providing additional facilities so that coal and water can be taken at the same time or, in the case of passenger trains, so that water can be taken while the train is at the regular station stop. The rates of flow from water columns can be increased in several ways.

(1) Increase the size of the pipe line serving the water column.

(2) Increase the size of the water column.

(3) Increase the flow head where the water column is served from a storage tank.

(4) Locate the storage tank as close as possible to the water column.

No fixed rule can be set for all cases as there are too many variable conditions between problems. Each case must have a separate study to produce the best results in the most economical manner.

Consider Operating Costs

Although the matter of original cost is very important, maintenance and operating costs should be given proper consideration. For example, an increased water column flow might be obtained by increasing the height of the storage tank instead of spending a small additional amount to increase the size of the pipe line from

the tank to the water column. However, the pumping costs due to the higher tank head may be increased to such an extent that the extra cost of the larger pipe line may be justified.

In connection with the location of water facilities to accommodate high-speed, through freight trains, it might be well to point out that the question of blocking street and highway crossings has become acute at many locations. To avoid this, water stations have sometimes been developed between towns where freight trains, often a mile long, can take water without blocking important crossings.

First Cost vs. Maintenance

The developing and enlarging of the equipment at main water stations has presented a cost problem that has been very important, especially during times of depressed business. The necessity for greater storage capacity and for faster deliveries to water columns has required larger and higher tanks and larger pipe lines, fittings, etc. This, in turn, has resulted in a wider use of all-steel elevated tanks of improved design since, in the larger sizes, it is more practicable to construct with steel than with suitable tank woods.

The retirement of water stations due to increased locomotive tender capacities has made many tanks available for re-erection elsewhere. It has been found practical and economical to cut down steel tanks by burning the sheets out in sections and welding them back together at the new locations. Wood tanks can also be moved successfully if proper care is used during the dismantling work to avoid damage to the materials. In cases where it is necessary to erect new storage tanks, careful consideration should be given to the types of materials to be used and to proper design so as to insure the lowest possible future maintenance costs.

Pumping Equipment

The replacement of obsolete pumping equipment with new modern equipment has often reduced maintenance and operating costs considerably. The newer types of equipment are much more efficient and lend themselves more readily for use with automatic controls, which, in turn, reduce operating costs. The savings effected by replacing cumbersome and worn out piston pumps or deep well pump jacks with modern electrically-driven centrifugal or turbine pumps have often paid for the installation costs within two or three years. Of course, the use of electricity is governed by the availability and cost of electric power, and it is not always possible or economical to convert to this type of equipment. In many cases, especially where the winters are severe, it has been deemed advisable to retain steam pumping plants so that the steam will be available for preventing the freezing of tanks, valves, pipe lines, etc. The maintenance and operating costs of these steam plants may be higher than similar costs for electrically-operated equipment, but a supply of water is insured during the winter months.

The importance of dependable water supplies has been greatly increased because of the general reduction in the number of water stations. This has emphasized the necessity for careful planning and use of quality materials and equipment to avoid costly maintenance and delays due to breakdowns.

Frost Protection and Drainage

The problem of frost protection is one of extreme importance to roads operating in northern climates where freezing weather is encountered for five to seven months of the year. The

water consumption during these months is usually greater than it is during the rest of the year and the maintenance of an adequate supply is imperative. Ordinarily, underground pipe lines give little trouble because of freezing since they are laid, wherever possible, below the frost line. However, care must be taken to prevent freezing in pump pits, meter and valve pits, water column pits and riser pipes to storage tanks. The best common insulation against heat transfer is dead air space and all commercial insulating materials depend more or less on this property. Certain kinds of wood, cork, rock wool, etc., because of their porous nature, contain an infinite number of dead air spaces and are therefore good insulators. Hollow tile and blocks of porous material of a concrete nature are also used because of their appearance and durability.

The frost-proofing of pits is usually accomplished by providing additional insulation across the top of the pit, although the walls are sometimes also lined. The amount of protection required depends, of course, on the climatic conditions. It is often necessary to provide heat by means of steam pipes, or electric, oil or charcoal heaters. The riser pipes to storage tanks are usually protected by a box, constructed primarily of alternate layers of wood and dead air spaces. Masonry frost boxes are also being used on many wood tank installations. The initial cost of a masonry frost box is somewhat higher than that of a wood frost box, but the maintenance costs are less. One bad feature of the wood frost box is that the moisture inside the box accelerates deterioration of the wood and reduces its insulating properties, increasing the possibility of freezing of the riser pipes.

Very often trouble is experienced by the freezing of the water in storage tanks, thus making the tank outlet valve or the operating rods and the indicator and automatic control floats inoperative. This is true especially where the water requirements are erratic and where the water is pumped from a stream or lake where it is already near the freezing temperature. This situation can be remedied partly by placing the valve operating rod and floats in oil tubes, or by housing in the tank tower and providing heat. It is good practice for maintenance men to canvass their territories yearly with the view of anticipating and preventing future freezing troubles.

Water Hammer

With the necessity for faster rates of flow from water columns, the problem of dealing with water hammer has become more and more important. Water columns are equipped with slow-closing valves which gradually choke off the supply and reduce the rate of flow in the pipe line to the point where the water hammer developed by the final closure of the valve can usually be handled by a relief valve. Ordinarily, water hammer does not present much of a problem when the water column is supplied by the railroad's own storage tank, as the pressure head is rarely more than 60 ft. or 26 lb. per sq. in. However, when a water column which delivers 5,000 gal. per min. is connected directly to a city main under a pressure of 75 to 85 lb. per sq. in., water hammer becomes a serious problem. In several such cases it has been necessary to install two or more relief valves in the supply line to take care of the surge. The subject of water hammer is very involved and it is practically impossible to predict the ef-

fects of water hammer upon city mains. In most cases it can be controlled by the use of proper relief valves, although this is not always true. In several cases involving city mains where increased flow rates were required, it became necessary to disconnect the water column from the city main and to install storage tanks because it was apparently impossible to stop the disturbance in the mains due to water hammer.

DISCUSSION

President Bechtelheimer: Thank you, Mr. Bost. At least, in so far as I am concerned, with my limited knowledge of water service requirements, this committee has presented an interesting and worth while report on a very timely subject. It has given consideration to the major factors involved and has possibly set up a yardstick by which others can check their practices.

The report is now open for discussion. I don't want to impose upon Mr. Bardwell (Engr. of Water Service, C. & O.), but I would appreciate it if he would take charge of the discussion.

(Mr. Bardwell came to the platform.)

Armstrong Chinn (Alton): Mr. Bardwell, I don't know much about this subject, but I am interested in the report nevertheless. One thing that I am particularly interested in is making economies wherever possible. The report mentions the replacement of old style pumping equipment with modern equipment which can be operated automatically, thereby reducing operating costs. The paragraph as written leaves the impression that the only type of automatic pumping equipment available is that run by electricity. While we have not used any other type on our railroad, I understand there are types of automatic pumping equipment run by gasoline engines, and even small Diesel engines.

I would like to have you tell me what you know about such equipment and whether it is available. If so, how efficient and reliable is it?

R. C. Bardwell (C. & O.): Mr. Chinn, unfortunately I do not have much information on that subject from personal experience. I do know that such equipment is available and that some is in use. Just what roads are using it, I am not able to recall at this time.

Mr. Chinn: The reason I am particularly interested in this question is that we have a location where we were considering automatic operation. However, the cost of electricity was such that we did not think we could justify an electrically-operated pump. We thought of putting in a gasoline engine. Whether we could have secured such equipment that operates automatically and successfully is debatable.

Mr. Bardwell: I understand there is gasoline - operated equipment available that can be arranged to start automatically. It is equipped with a starter, and the starter is controlled by the same kind of automatic arrangement that starts the electric equipment. Unfortunately, I am unable to give you any information on the subject from personal experience, and I hesitate to draw on my imagination.

President Bechtelheimer: Is there anyone in the room that can add

information on the question that has been raised?

R. E. Caudle (M. P.): We have an installation of duplicate-unit gasoline engines that has been in service for two years. The automatic cut-out is operated electrically by the storage battery attached to the engine. We have this equipment so interlocked that if one engine fails, the float will go down and cut in the other engine. We have not had a failure of this equipment in two years, which is most desirable because it is at a very important water station. At one time one of the engines kicked out, and when the float came down to the predetermined level, the other engine cut in automatically and took up the load.

Mr. Chinn: I have another question. A little while ago Mr. Corey wanted to know how to fix up bridges for nothing. I would like to know how to clean out a six-inch discharge line, about a mile long, for nothing.

Mr. Bardwell: When it comes to cleaning pipe lines, about the only way to be sure that they are clean is to use one of the various mechanical type cleaners. Many of the railroads now are using hexa-metaphosphate, or some compound containing dehydrated phosphates, to keep scale from depositing in pipe lines, but that does not help those pipe lines very much that are already scaled up. We had hoped that it would, but we found that while it softened the scale, it did not take it out, so we had to resort to the mechanical method of cleaning.

J. E. Tiedt (C. R. I. & P.): We have cleaned pipe lines successfully with paper balls, and the cost is close to nothing.

Mr. Chinn: How did you do it?

Mr. Tiedt: At one of our treating plants we had a soft accumulation in the line. It was not hard lime; the incrustation was a sort of mud. We made a paper ball out of toilet paper; inserted it in one end of the line; put the pump pressure behind it and pushed it through, cleaning out the line. I also partially cleaned seven miles of pipe line with chopped ice. There was nothing in the line except an accumulation that came from a river; part mud, some sand and some organic matter. The ice was chopped into square blocks, put into the pipe line and pumped through. All we had to do in this case was, of course, to change the flow characteristics in the pipe line. When that was once changed, the accumulation was readily flushed out.

Mr. Chinn: When you are flushing toward the tank, what do you do with the accumulation of mud that comes out?

Mr. Tiedt: The pipe line was seven miles long. We flushed it two ways, at the pump station and also at a connection near the tank, so as to keep the pipe line pressure within safe limits.

Mr. Chinn: In seven miles, wouldn't the ice melt before it reached the end?

Mr. Tiedt: Yes, it is estimated that only a portion of the line could be thoroughly cleaned in this manner. However, it did a very good job, because it reduced the pressure on that particular pipe line from 135 lb. to 115 lb. We did not tap the line throughout its length to see if we had it entirely clean, but on a short line that might be done very successfully.

Mr. Chinn: Getting back to the paper ball method. Did you compose the ball entirely of toilet paper?

Mr. Tiedt: Yes.

Mr. Chinn: That paper is ordinarily very soft and will disintegrate rapidly in water.

Mr. Tiedt: The line is about a mile and a quarter long. The ball was in it about 25 min. before any disintegration showed up in the tank. In 45 min. the ball came through. I do not believe that it absolutely cleaned the barnacles out of the line, but it did reduce the pressure.

Mr. Chinn: I can see that it would do that because it would force the water to run at a high velocity around the edge of the ball. How tightly did you wind the ball?

Mr. Tiedt: We left that in the hands of the pumper, but it was wound rather tightly.

Mr. Chinn: Did you tie it in any way?

Mr. Tiedt: No. It was wound similar to the winding of a ball of twine.

There is a kind of sponge ball on the market now which can be put through a pipe line for cleaning. We have never used one because I have been fearful of getting it stuck in the pipe.

Mr. Chinn: That's right. The advantage of the toilet paper would be that if it did get stuck it would disintegrate, and you would at least have no worse condition than existed before. In cleaning out limed up pipes, do you use muriatic acid?

Mr. Tiedt: We have used the same agent as mentioned by Mr. Bardwell—hexa-meta-phosphate—over a period of time.

Mr. Chinn: We are spending $2,500 right now at Bloomington, Ill., to clean out some water lines that are gummed up.

Mr. Tiedt: We have cleaned a lot of lines to provide faster delivery through trunk lines, and also to reduce the electric power bill.

Mr. Bardwell: I think you will find that the cost of mechanical cleaning is much less than by muriatic acid.

Mr. Chinn: But you can't clean a gummed up pipe very well, can you?

Mr. Bardwell: It depends on the size. We have cleaned 12-in. lines as long as three miles mechanically. We put in the machine, turn the pressure on and let it bore its way through. Such machines are on the market and are available on a rental basis from a company in New York and another company in Los Angeles, Cal.

Mr. Chinn: Is the pipe you cleaned straight, or did it have angles?

Mr. Bardwell: In the larger size pipes—say, 10 in. and above—it will go around a 90-deg. bend. In smaller pipes, it might not. I would not want to risk it in smaller pipes, myself. We cleaned a six-inch pipe at Columbus, Ohio, with a pressure machine. This line had better than a half-inch coating in it in places, and the machine went through all right. The coating was soft, however.

Mr. Tiedt: In connection with the high rate of delivery of water through water columns or tank spouts—say, 5,000 or more gallons per minute—has anyone any safety suggestion as to locking the spout

in tender manholes; has anybody ever done this?

Mr. Bardwell: The question of rapid delivery of water to locomotives nowadays is a hot subject. It seems that many operating officers think a large amount of time can be saved if the actual rate of delivering the water to the locomotive can be speeded up. That has raised the question as to what is a safe amount of water for a fireman or a hostler to handle.

You are all familiar with the telescopic spout, open at both ends. As a safe factor, we had set the limit between 3,500 and 4,000 gal. Several railroads, I understand, are going as high as 5,000 gal., or possibly a little better.

I certainly would be interested in hearing of any such experience. Has it increased the hazard, or have they gotten away with it successfully?

Mr. Bost: We have a water column installation where we have a delivery rate of 5,100 gal. a min.; another, 4,950; and a third, 4,400. We have had no particular trouble where the tender heights have been sufficient, but on low tenders there is some trouble in getting the water into the tender.

Mr. Bardwell: Do you provide any means for locking the spout in the tender manhole?

Mr. Bost: No.

Mr. Bardwell: Is it just held there by the fireman's foot?

Mr. Bost: Yes.

Mr. Bardwell: If the engine doesn't happen to be spotted right for the water column, is there not a hazard of personal injury?

Mr. Bost: Possibly there is, if the angle is great.

W. A. Sweet (A. T. & S. F.): We experienced the same trouble as everyone else in trying to get a high delivery rate of water. At one time we tried putting on a safety chain. The mechanical department demanded it because of the hazard involved, but it did not go over very well. If they did not get spotted just right, they could not make the hitch with the chain, and the practice was abandoned. As a result, in most instances, I think it was necessary to adjust the valve to restrict the flow of water to a point where it can be controlled by the fireman's foot, rather than to get the maximum flow of water.

I am like Mr. Bardwell, I would like to know of some way to get the delivery desired, with safety.

Mr. Bardwell: It is a live subject. It has been my experience that even when you arrange for delivery of, say, 4,000 gal. per min., the fireman or hostler will open the valve wide and won't get this delivery unless he is checked up. If there is a safe way of getting the maximum of water, I believe that maximum figure should be brought out so that other railroads of the country can have something to shoot at.

R. D. Ransom (C. & N. W.): I am not experienced in this matter, but I presume that if you were building a new station, you would put in a little larger facility than the old one. I take it you are speaking of old stations?

Mr. Bardwell: Not necessarily. It is the actual rate of delivery of water from the water column to the locomotive tender that is in question.

Mr. Ransom: But if the water column was larger, it would deliver more water without so much velocity.

Mr. Bardwell: The actual velocity of the water going through the spout and into the tank would be the same whether it came out of a 10-in. or 12-in. column.

Mr. Ransom: True! I was thinking that if you had a larger volume of water flowing, it would not have to flow so fast to deliver the same amount in a given time.

Mr. Bardwell: The spout through which the water is delivered is the same in either a 10 or 12-in. water column. The 12-in. water column is the largest made at the present time.

Mr. Ransom: I appreciate that, but I thought you might make it 16-in.

Mr. Bardwell: The delivery of water up to the water column is merely a question of engineering design. Facilities can be arranged so that any amount of water can be delivered to the point where it is desired. Charts are available from practically every water column manufacturer, which show how much water will be delivered through various sizes of water columns with different sizes of pipe leading up to them, and various heights of water in the storage tank. As I have said, that is merely a question of engineering design, and the information is readily available.

Mr. Tiedt: I wonder if anyone has ever tried to increase the flow to water columns by installing automatic electric equipment in the delivery line?

Mr. Bardwell: I don't know of any such installation. There are a number of installations where they pump directly from the source of supply to the water line, but none that I know of where a pump is used to boost the delivery.

President Bechtelheimer: Mr. Bardwell, we certainly thank you for coming here and helping us out. The committee is discharged. I especially thank Mr. Bost for his presentation of the report.

The Detection and Elimination of Termites in Railway Structures

Report of Committee

T. H. Strate, *Chairman*, Div. Engr., C. M. St. P. & P., Chicago; F. H. Masters, *Vice-Chairman*, Ch. Engr., E. J. & E., Joliet, Ill.; E. L. Rankin, *Vice-Chairman*, Archt., G. C. & S. F., Galveston, Tex.; Maxfield Bear, Estimator, C. & N. W., Chicago; H. I. Benjamin, Chm. Sys. Ins. Com., S. P., San Francisco, Cal.; C. W. Boyce, Supv. B. & B., I. C., Vicksburg, Miss.; H. B. Christianson, Div. Engr., C. M. St. P. & P., Savanna, Ill.; T. B. Coolidge, Asst. Supv. B. & B., N. Y. C., Syracuse, N. Y.; J. E. Heck, Brg. Insp., C. & O., Peru, Ind.; H. Heizenbuttel, Supv. B. & B., C. & N. W., Norfolk, Neb.; N. D. Howard, Mgr. Ed., Ry. Eng. & Mtce., 105 W. Adams St., Chicago; W. W. Kerr, Jr., Instman., C. & N. W., Chicago; P. L. Koehler, Div. Engr., C. & O., Ashland, Ky.; C. A. Landstrom, Mast. Carp., C. B. & Q., Burlington, Iowa; B. W. Logan, Gen. For. B. & B., C. R. I. & P., Little Rock, Ark.; C. A. J. Richards, Mast. Carp., Penna., Grand Rapids, Mich.; F. H. Soothill, Ch. Estimator, I. C., Chicago; L. R. Thompson, Supv. B. & B., M. & St. L., Oskaloosa, Iowa; K. J. Weir, Water Insp., C. M. St. P. & P., Chicago; B. M. Whitehouse, Insp., C. & N. W., Chicago.

T. H. Strate
Chairman

The subject assigned to the committee is an interesting one and one which becomes more important as evidences of the activities of termites, or "white ants" as they are commonly called, are found over ever-increasing areas.

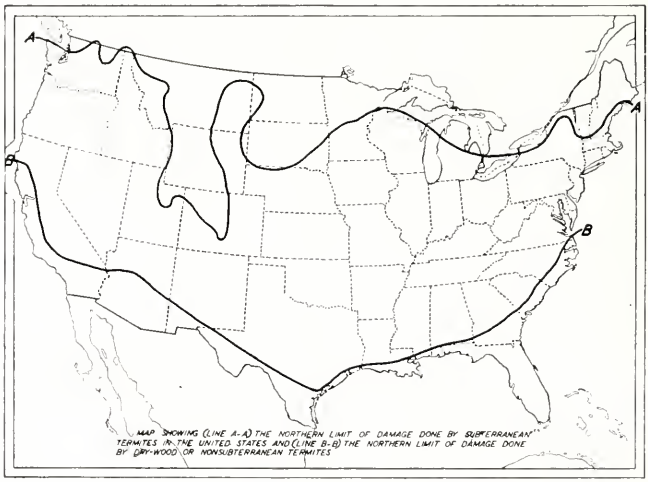
Perhaps before we go into this subject further some reference should be made to the role which the termite plays in nature and the following is quoted from one of Dr. Herman Von Schrenk's writings. "We are frequently asked by people why there should be such a pest. It is almost a truism that few things occur or act in our world which do not have some significance, or which do not play some part in the general economy of nature. Unfortunately, in many cases, we are unable to trace or understand what the particular significance may be. In the case of termites, however, we have a fairly good appreciation of the role which these insects have played for many millions of years. Briefly stated, they are one of the leading scavengers of the world. Whenever any organic matter, particularly the trunks of trees, branches, leaves and other vegetable parts die, the termites begin their activities and in very short order they more or less reduce the dead material to what may be called a soil condition. They do this not only with wood but with all sorts of other organic material. They work hand in hand with wood-destroying fungi, with the numerous bacteria and other scavenger insects, worms, etc. Picture to yourself what the surface of this earth would look like if all these scavenging agencies were eliminated for a brief time. I think you may be surprised at the thought that within an incredibly short period, say 10 years, if not less, the surface of the earth would be so encumbered with dead matter that there would be no opportunity for living organisms to find a foothold. By eating and converting dead wood, the termites therefore

have played and are still playing a very particular role, making it possible for succeeding generations of other living organisms to develop and prosper.

"Assuredly, we have very little to criticise if they follow their age long instincts and destroy wood and other organic matter irrespective of where they find it. It is just too bad for us that much of this dead wood is in houses, buildings and other structures where their presence is undesirable, but we can hardly blame them for failing to recognize this. To those who are philosophically inclined, I strongly recommend the reading of that delightful book which appeared a few years ago, by the great philosopher, Maeterlinck, entitled, "The Life of the White Ant." He not only dwells extensively on the picture which I have just touched upon, but speculates as to the possible correlation which may be drawn between the amazing development of these remarkable insects and the human family."

Termites are more or less social workers with other ants and have a well organized community composed of workers, soldiers and reproducers (the "king" and "queen"). Only the latter two have reproductive powers but they have a long span of life, often as long as 15 or 20 years. At one stage of the life of the king and queen, they have sight and wings for a short time, which enables them to find a new location and start a new colony. The king and queen take care of the young until the family has increased enough to feed them, after which they remain in the nest and the queen gradually loses the power of locomotion and becomes practically an egg-laying machine. The number of eggs produced is enormous and most of the ants become sightless grayish-yellow workers (which are erroneously called white ants), while others become soldiers who protect the workers.

Certain conditions are necessary for the existence of termites, namely dampness and darkness, and the fact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MAP SHOWING (LINE A-A) THE NORTHERN LIMIT OF DAMAGE DONE BY SUBTERRANEAN TERMITES IN THE UNITED STATES AND (LINE B-B) THE NORTHERN LIMIT OF DAMAGE DONE BY DRY-WOOD OR NONSUBTERRANEAN TERMITES

Copy of Map Issued by the U. S. Department of Agriculture, Showing the Limits of Termite Activity in the United States

that they do work under cover makes their detection all the more difficult and often allows them to do considerable damage before being detected. As stated above, these insects avoid light and burrow from their nest to nearby buried wood, and it makes no difference to them whether this wood is a log in the forest or a vital portion of a building. As long as they can have access to the wood their activities continue and after a while the interior of the wood is practically removed so that what appeared to be a sound piece of timber is a mere shell. This may create a very hazardous condition.

Termites occur in practically every state in the United States, and outside of the United States all over the world in tropical and temperate lands. A map has been prepared by the United States Department of Agriculture, which shows the widespread area of their distribution in the United States.

Any kind of wooden structure may be affected, although buildings well constructed and maintained are much less liable to attack than those poorly built. Age makes no difference to the termites. They may be found in both old and new construction.

Nature of Attack

The nature of attack in the United States is generally through the ground, which means foundation walls, posts and parts that are in contact with the soil. This is the nature of attack of the common subterranean termite. On certain parts of the Pacific coast there is an aerial form of termite, which attacks buildings from the air.

Termite nests or colonies are rarely found because they are always hidden underground. The appearance of termites in a building does not mean that the so-called "nest" is in the building, or is anywhere near it. It may be a long way off. The workers are great travelers, building tunnels all through the ground in their search for food. Many species of termites actually grow their own food. Upon a specially prepared base, they cultivate various fungi, or mushrooms.

The subterranean termites get into a building only from the soil. In other words, there must be some approach from below the ground into the building. They cannot start their operations by coming into a building through doors or windows. If fire wood is brought into a building, even if it contains counless workers, they cannot start operations in the woodwork of the building itself. One of the most likely points of entrance is through foundation walls, when, after a period of time, cracks form in the mortar, thereby forming ready points of entrance. This is particularly true where lime mortar has been used as the termites can dissolve lime mortar. The second point of attack is in and around window casings, placed in depressed points like basement windows, coal windows, stairways, etc. Posts used for walls of storage bins and door frames similarly situated in the basement are frequent points of attack. Water and other types of pipes passing through concrete floors or walls frequently offer points of entrance. In structures with no basements, the method of entrance may consist in building shelter tubes vertically from the ground.

In buildings with concrete walls, or of slab construction, points of entrance have been found through air pockets in improperly tamped concrete, through shrinkage cracks, or between slabs separating sufficiently to form cracks.

Evidence of Presence

The first and most positive indication of the presence of termites in a building is the appearance of swarms within the building. This always means that the workers are in the woodwork of the building. If there is no such observation, the next thing to do is to examine the woodwork on the lowest floor, preferably from the cellar. If the ceiling of the basement consists of lath and plaster, a sufficiently large strip of the lath should be taken off and an examination made of the joists, studs and top of the wall. It is important to look for the shelter tubes or carton-like building material which will usually be in evidence where the insects are at work.

The dry-wood termites fly and attack timber in dwellings, dead trees, etc., and can exist in wood containing less than 12 to 15 per cent of moisture. They do not follow the grain of the wood continuously, but cut across and excavate through it longitudinal chambers of limited length connected by tunnels. Their pellets of partly digested excreted wood sometimes completely fill or block up the burrows and sometimes the pellets are expelled as dry droppings from the infested wood and serve as a warning of infestation. The subterranean termite, as mentioned before, burrows through the earth and attacks wood indirectly from the earth, with which they must maintain contact to obtain the moisture so necessary to their life.

Termites appear to be sensitive to vibrations; they are seldom found in railroad ties over which there is frequent heavy traffic, or in the wood work of mill or factory buildings in a vicinity where heavy machinery in motion would cause vibration. The possible reasons are that vibration would not only interfere with their method of communications, but also, if heavy enough, would break off shelter tubes. If the whole or a part of a structure containing untreated wood shows signs of failure which cannot be attributed to natural causes such as depreciation, load, etc., it should be examined for termites to determine if the failure was due to their presence.

How to Detect

Termites carry on their destructive work hidden from sight, seldom revealing their presence. However, the swarming, usually in the spring and fall of the year, is certain evidence of their being in the vicinity. The presence of shelter tubes is another evidence of presence. Termite damage is often mistaken for rot as it is difficult to distinguish between the two. Actually, rotting follows termite attack because they carry on their bodies the fungus spores which cause rot. Therefore, if one should discover rotten timber, this might indicate a previous termite attack. They may be also detected by the fecal pellets dropped from the workings of dry-wood termites.

Solid wood struck by a hammer rings clear, while timber eaten out by termites will give a dull thud when struck. Weakened timber is also detected by a sharpened pick or bar. Clean cut holes in books, papers, clothing, etc., are good indications of the presence of termites.

Nature and Extent of Damage

The extent of termite damage is difficult to determine. If let alone they will destroy practically all wood, particularly the spring growth of coniferous woods.

It is estimated that termites do from $40,000,000 to $50,000,000 worth of damage annually in this country to wood in buildings, to

fences, to poles and books, clothing, leather goods, etc. This is a large item, and there is an idea that a very dangerous condition exists. This has been brought to public attention by both the technical and popular press greatly in recent years, and as in many other lines, has produced a genuine fear in places as to the use of wood in the building of houses and other structures. Little anxiety need be felt provided proper precautions are taken in the use of wood and methods of construction are followed which will prevent access of the insects into the building. In short, all termite damage to man-made structures may be laid primarily to improper construction.

Methods of Elimination

The problem of eliminating the dry-wood or non-subterranean type of termite is simpler than in the case of the subterranean type. Both gas and heat to 130 deg. and over are effective against them.

The subterranean type is much more destructive. The workers and soldiers can be destroyed by removing their access to a supply of moisture or water. No attention need be paid to those left in the building or structure. They will promptly dry up and die.

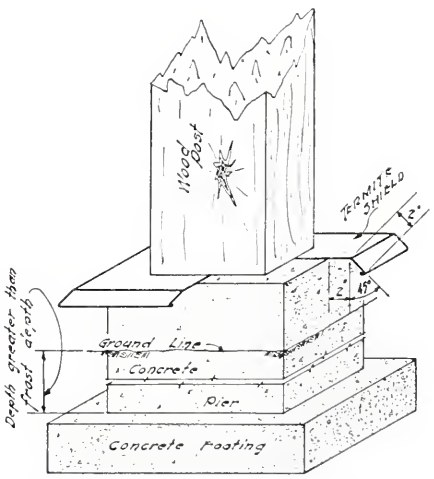
Removal of the shelter tubes will accomplish the same results unless they have runways within the walls and can reach moisture from such sources as a leaking water pipe, condensation, etc.

In reconstruction work, care should be taken to correct the errors of original construction, the first step being to inspect all wood below the line of the first floor. All structural members should be replaced if weakened by the insects—using pressure-treated woods. All wood removed should be burned. If foundation walls are cracked and porous, replace the top with good cement masonry and at the same time install metal termite shields. Where post and pier foundations are found, cap with termite shields.

Generally speaking, the solution lies in the closing of the point of entrance, which necessitates careful study of each particular structure, floors, partitions, doors and windows, each requiring special attention. Elimination of contact between earth and wood, removal of all debris, roots, etc., proper ventilation under floors and in basementless spaces—and last but not least—proper drainage of wet or damp ground, will go a long way towards curbing the termite infestation. Where it is necessary to have wood in contact with earth, see that it is pressure treated.

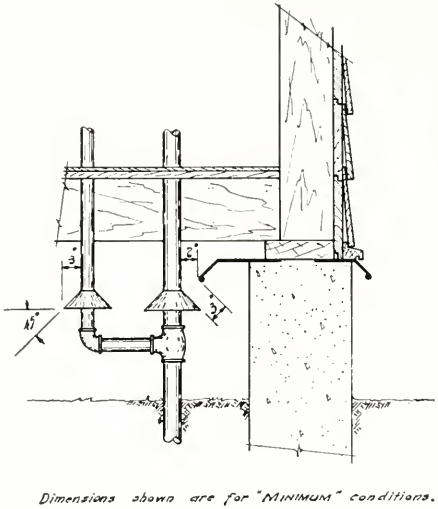
Termite-Proof Construction and Recommendations

The sum and substance of any recommendations for the construction of buildings to resist termites is,



Sketch of Termite Shield Used Between Wood Post and Concrete Base

of course, answered by a simple statement, "build to prevent the entry of the insects." The design should be such that the insects cannot possibly get at the wood work.



Sketch of Metal Termite Shields Used Around Pipes Entering a Building and at the Top of Foundation Walls

A study of suggestions and recommendations in various publications and reports of the government, the American Wood Preservers' Association, the National Lumber Manufacturers' Association and other organizations and commercial concerns, to all of whom we are indebted for our information, shows a very marked similarity of instructions.

The 1934 Proceedings of the American Wood Preservers' Association contains a discussion on termites by Dr. Von Schrenk, who makes the following points in connection with the subject of design, which appear to be the basis of today's practices.

(1) Use only cement mortar in the construction of foundation walls.

(2) Have the foundation walls sufficiently high above the ground so that wood-work of any sort will be removed from the surface of the ground.

(3) Provide all foundation walls with approved copper or other long-lived metal shields. The strips of the shields should be soldered where the ends overlap. Furthermore, the overhang of these shields should be at least three inches beyond the wall and the 45-deg. bend should be at least two inches wide. The shields should extend on both sides of the foundation wall, that is, inside and outside of the building.

(4) Irrespective of whether shields are used, the top surface of the foundation wall should always consist of a coating of rich cement mortar carefully trowelled.

(5) All openings for window casings, cellar doors or other openings through foundation walls should be covered on all surfaces with rich cement mortar so that there may be no chance for termites to get from the foundation into the wood casing.

(6) Concrete slabs should provide a triangular depression where the slab joins the vertical wall or where adjacent slabs abut against each other. After the concrete has hardened, these joints should be filled with a fairly plastic coal tar pitch. Asphaltic compounds are of no use whatever.

(7) When there is an unexcavated section under the house, wherever possible lay a thin concrete floor on the soil so as to prevent the entrance by means of vertical tubes to the overhead wood-work. Use pitch seals between slabs and at the walls.

(8) In cellars, lay the concrete first, and put any boards or posts on top of the concrete.

(9) Have all pipes of whatever sort provided with copper shields near the point of entrance into the building.

(10) Where wood has to come in contact with the ground or where it is located very close to the ground as in porches, use only treated lumber, preferably treated according to the specification of the American Wood Preservers' Association, with coal tar creosote. Termites will not attack creosoted wood where the treatment has been efficiently conducted.

(11) When possible, cover the outside of the foundation wall with a good quality of coal tar pitch.

Use of Chemicals

The use of chemicals to sterilize or poison the ground under buildings and around outside of foundations is a later development, using a copper sulphate solution, with four pounds of crystals to five gallons of water in the first case, and full strength Orthodichlorbenzene in the second case. In the case of the latter, the chemical should be applied in the bottom of a trench 30 in. deep and at least 12 in. wide around the foundation walls. The soil should be saturated at the rate of one gallon per ten linear feet, the soil then replaced to within three inches of the surface and the treatment repeated. This treatment is not permanent, however. A petroleum-creosote solution may also be of benefit if it is not desired to use the chemical mentioned above, which has a number of objectionable features in handling.

The termite is not a new insect in the world but is probably one of the oldest forms of life on the globe. The damage caused by it is no doubt exaggerated. Remember that termites must have their home in the ground, where they find an unfailing source of moisture. Destroy the ground contact and you destroy the termite. It cannot stand exposure. Termites are not brought into a building in either new or old lumber, nor is lumber used in buildings properly constructed in danger of being damaged by termites.

DISCUSSION

President Bechtelheimer: Mr. Strate, you have given us a report that is easily read and simply told, and I am sure any reader can understand it and use the information given. I imagine that many of us will start immediately on an intensive search for evidence of termite infestation.

G. S. Crites (B. & O.): I note that under item No. 6 the last sentence says: "Asphaltic compounds are of no use whatever." I would like to know whether termites eat asphalt.

Chairman Strate: I can not tell you. This is a recommendation taken from Dr. Von Schrenk's writings and I think he infers that the termites do eat asphalt.

H. M. Church (C. & O.): Asphalt has no toxic properties and, therefore, is considered of no insurance against termite infestation. Termites will attack certain creosote-treated woods that are very lightly treated. That is, if there are insufficient toxic properties or the creosote has volatilized.

W. J. Burton (M. P.): In the next to last paragraph, speaking of chemicals, something is said about "in the first case" and "in the second case." I wonder if something hasn't been omitted. I would also call attention to the fact that Orthodichlorbenzene is not used

full strength; it is used extremely diluted. I think something must have been omitted. It does not make sense the way it reads. I wonder if Mr. Strate can explain that. I want to know what the first and second cases are. Apparently, one compound is recommended in one case and one in the other.

Chairman Strate: One case is where you use the copper sulphate solution, and the other case is where you use Orthodichlorbenzene.

Mr. Burton: I think that is in error. I don't think that should be used full strength. I don't believe you would be around here if you tried it.

Chairman Strate: That is the only explanation I can give for it.

President Bechtelheimer: I wonder if Mr. Meyers, President of the American Wood Preservers' Association can supplement that part of the report?

Mr. Meyers (Inter. Creo. & Const. Co., and Pres. A.W.P.A.): Of course, Orthodichlorbenzene is a poisonous chemical and if much of its vapors were inhaled, the effect would be quite serious. The idea is that by injecting this volatile compound into wood it turns to a vapor and works its way through the channels that the termites have made. I have never used the material. It is not one of the standard preservatives of the American Wood Preservers' Association and so its action is one I would not be entirely familiar with as to the strength in which it is used. It seems doubtful that it would be used in full strength.

President Bechtelheimer: Thank you, Mr. Meyers. I would like to call on Mr. Arnold.

W. P. Arnold (Wood Preserving Corp.): The use of dichlorbenzene, I think, has been pretty well discredited as a sort of poison, and I believe that later practice has shown creosote mixed with petroleum—which may be crankcase oil or some other waste product—to be far more effective as far as destroying termites is concerned. The creosote treatment should be used in quite heavy doses; properly, one gallon of the mixture to one lineal foot of foundation wall. There should be two applications of that dosage: one down near the footing area, and one near the top, so as to seal off the top and bottom.

I don't believe that copper sulphate has given very good results either as a soil poison; in fact, soil poison, in general, is considered a poor substitute, although it is an expedient where economy is necessary.

Incidentally, dichlorbenzene is misspelled. It should not be "ortho."

President Bechtelheimer: Mr. Burton of the Missouri Pacific, and Mr. Meyers and Mr. Arnold representing commercial treating companies, are members of the American Wood Preservers' Association and of its Executive committee. We are glad to welcome these gentlemen to our meeting.

Mr. Meyers: Mr. Chairman, may I add another word please. Mr. Strate's paper is full of excellent information about termites. The little difference of opinion that was expressed on the floor a moment ago is mainly due to the fact that it deals with one of the most difficult phases of termite-killing that exists. That is, when termites are already in wood in a building, it is exceedingly difficult to be sure of eliminating them, and of prevent-

ing their starting to work again at a later time. The only sure method is to have the wood treated while the building is being erected. That gives surety to termite prevention.

Then I want to say also for the benefit of those members of the American Wood Preservers' Association who came to listen, that it certainly is gratifying to see a subject so closely related to our industry being discussed before this group. It is pleasing also to see the American Wood Preservers' Association records cited as authority for what you present here.

We in the wood preservation industry were astonished a few years ago to be told authoritatively that only three states in the Union did not show termite attacks on wood. Termites had been found in all but three states. The map accompanying your report shows that they are in every state. This subject is particularly timely now, when our government is buying, this week, millions, not to say billions, of feet of lumber.

We hear of substitute materials, substitutes for wood; yet, wood today is being used more than ever. Facts such as Mr. Strate and his committee have given you make you indebted to him and his committee, for if you follow their recommendations you are making an investment in efficiency.

President Bechtelheimer: Thank you, Mr. Meyers.

L. E. Peyser (S. P.): Assistance has been given through the use of petroleum-creosoted-treated material in buildings to prevent the ingress of termites. That is all right in the case of new construction, but we have a lot of buildings without treated materials, in which the hazard of termites occurs.

I have had very good success using a light creosote, or hydrocarbon with creosote content, sprayed on or heavily brushed on fir or softer woods. It penetrates a considerable distance and it has been a deterrent in areas surrounded by termite infestation, where it has been possible to keep them out of buildings that have been creosote-treated. I think it would be valuable to consider it from that angle, that is, to attempt to prevent them from entering in the first instance.

F. H. Soothill (I. C.): I should like to call attention to the fact that a certain amount of judgment must be used in selecting a type of treating material to use under certain conditions. In the last six months, our division people let a contract for treating a warehouse which was later occupied by a grocery concern for the storage of sugar. As a result, about 40,000 lb. of sugar were damaged. In warehouses where it is known that commodities may be stored which are susceptible to the odors of certain treating materials, extreme care should be exercised in the selection of treating materials.

We had a treating job at Memphis, Tenn., where it was necessary, to exterminate termites, to drill all of the concrete floor, more than a half block in area, applying poison through the floor, around the columns and around the outside walls.

We have had so many solicitations from manufacturers of the various treating compounds that we have found it expedient during the last five years to conduct our own tests of these compounds. We have a termite test bed. As solicitations are made, we get a sample and treat one or two stakes and put them in with a control stake.

We pull these stakes at intervals and keep a log of their condition at the time of inspection. We haven't arrived at any conclusions yet, although some of the stakes are gone. However, I think that we will have some very valuable information when we finally finish our tests.

In certain states there are laws governing the application of treating compounds. For example, in Louisiana, a railroad crew can not apply termite-treating oil. The work must be handled by a licensed applicator.

Another point, as already mentioned, is that some of these termite oils give off gases. I remember reading in a fire protection bulletin about a very disastrous fire that resulted from the treating work that was going on within a confined area. In a room where the gases were accumulating, a man was dragging an extension cord and in some way broke the bulb. The spark ignited the gas, blowing the building to pieces, and killed two or three men.

There are many points to consider in the use of these various compounds. Where railroads are permitted to apply their own materials, I think that certain crews should be trained in the proper use of them.

President Bechtelheimer: The report strikes me as one of value to almost everyone, even without first knowing all about these questions of a more or less scientific nature. It was just a couple of days ago that I first saw a termite. I have heard about termites for many years, and I was very much surprised to learn, as stated in this report, that they are white ants.

L. D. Hadwen: I would like to ask whether there has ever been an attempt made to detect termites by means of x-rays, or something of that nature?

H. M. Church: I do not know of the use of any such method, but there are two periods in the year when the ants swarm, and that gives one a very definite idea of their presence. For more than five years the C. & O. has been using salt-pressure-treated timber in its repair work where we have had to remove timbers largely because of decay or termite attack. These salt treatments of various kinds are available very economically, and are used where we can not use creosote due to its fumes.

R. R. Clegg (American Lumber & Treating Co.): The Detroit Edison Company's Research department has made x-ray studies of poles and I think it may have some information as to decay and termite damage in poles.

W. Walkden (C. N. R.): I would like to know if there is any authentic information available as to how fast the line shown on the accompanying map is advancing northward?

President Bechtelheimer: Mr. Walkden lives in Canada and is concerned about termites getting up there. Mr. Strate, can you tell him about how quickly he can expect termites in his territory?

Chairman Strate: I really don't know.

E. T. Howson (Ry. Eng. & Mtce.): It seems to me that there is one thing about this report that we ought to carry away with us, entirely aside from some of the intricate technical information. This report brings home to the members of this association the fact that there are probably ter-

mites in their own structures. At least, it should put them on their guard and give them information that will help them in determining whether any of their buildings are infested.

I have in mind one railway maintenance officer in the Middle West who thought that he had no termites until he set about to find out how he could assure himself to that effect. He then went out and looked for termites and found them in dozens of structures on his railway. He has since showed other men on his railway how to recognize them and they have since found them.

In conversation with men on other railways running through the same territory, and frequently serving the same cities, they tell me that they don't have termites; that is, they think they don't.

If this report will help the men who are in daily, intimate contact with their structures, to determine how to identify the presence of termites, it will have served a very constructive purpose. It is a valuable report to this association because of that fact.

H. B. Christianson (C. M. St. P. & P.)*: We have found termites at three locations on our Dubuque and Illinois division in the last few years. They have been found only in buildings where there is actual contact of wood with the earth and never, thus far, in wooden bridges. The three points are Savanna, Ill., Dubuque and Nahant, Iowa.

At Savanna, termites were found in a sand storage bin which we renewed 2½ years ago. All of the posts and timbers of the old structure were destroyed by burning and we have found no further evidence of termites at this terminal.

At Dubuque, termites had destroyed sills under a five-stall wood extension of the roundhouse. These were replaced with creosoted wood last year. In our 1940 building inspection we did not find any further evidence of termites anywhere at this terminal.

At the Nahant terminal, near Davenport, Iowa, many of the buildings are infested. Termites were first observed in an old section dwelling, which was practically destroyed by them. A hay shed near the stock yard, removed last season, was infested with termites, but we have not found any in the stock yards themselves. It does not seem that they will attack cedar posts as long as there is cedar oil in the wood. An ice house at Nahant does not have them, but practically all of the stores department structures do, as well as other miscellaneous small buildings. Last year we found that much damage had been done to the pipe duct covering in the roundhouse, which is in contact with the ground.

We have not attempted to drive out the termites in any infested structures up to this time, except through the renewal of foundations, floors, etc. We placed concrete footing blocks and creosoted wood posts under a store department platform this year. We renewed the floor in a stores department mill room in 1938 with concrete, and have found no more termites in the wood of this structure. In a car department material platform, we renewed timber footing blocks with concrete this year, and painted the untreated posts with creosote. We will observe what effect such painting has.

As stated above, the buildings that have been attacked are the

*Comment submitted by mail.

smaller ones that were built on wood sills. Where the buildings set on concrete foundations and the wood is not in contact with earth, we have had no trouble thus far.

As to detection, our chief carpenter, V. E. Engman, had quite a bit of experience on our Terre Haute division previous to coming to the D&I division. He often finds evidence of termites in the form of cast off wings, white in color, of the reproducing termites. The excrement with which they build tunnels, and which is present wherever termites exist, is a sure indication of their presence, or that they have been at work. Where termites are active, of course, they can be uncovered by probing with a bar.

C. A. J. Richards (Penna.)*: Last fall we found evidence of termites in a small passenger station at Hobart, Ind., a small brick building built about 1915, with a full basement under the central portion where the heating plant is located. Settlement of the floor in the women's toilet, near one end, led to an investigation which disclosed that the floor joists were almost entirely gone. The concrete slab floor was held up only by being wedged tight against the side walls. An air vent in a window at that end had been filled up gradually as cinders were dumped in a driveway and there was no ventilation whatever under this part of the building. Fortunately, this room was not used much and no accident occurred. Repairs, replacing joists, floor, etc., cost nearly $200.

C. A. Landstrom (C. B. & Q.)*: A few years ago one of my foremen reported that ants were eating into a timber bulkhead at a pile trestle bridge on a branch line. In making an inspection of this bulkhead a day or two later, I found that we had a colony of termites. The face side of the timbers did not show any signs of deterioration, but in taking the timbers out, we found them honeycombed from end to end, with the exception of a thin shell on the face that had not been in contact with the ground.

All of the infested timbers were removed, and the dirt, which consisted of a sandy loam, was cleared away for a considerable distance around bulkhead. Then the ground was saturated with creosote. A new bulkhead was then installed. It goes without saying that creosote-treated timbers were used for replacement.

I believe we were fortunate in discovering these termites before any other parts of the bridge had been attacked, as we have not been troubled since. This location was in the eastern part of Iowa.

About eight months ago we found where some cotton fabric fire hose at a grain elevator in Council Bluffs, Iowa was being badly eaten by some pests. When reported by the elevator men it was thought that mice were gnawing the hose, but when we made an inspection we found that termites were the culprits.

This hose was in a small house, coiled on a wood rack, about two feet above the ground. Evidently the termites had not been there very long as the hose had been tested out a short time before and showed no evidence of damage at that time. Nor did we find on close inspection where any of the wood rack was attacked.

The hose house was given a thor-

*Comment submitted by mail.

ough cleaning and all wood was doped with creosote, and we have had no evidence of termites at this location since. The soil at this place is very sandy, presenting an ideal condition for termites to work in.

From this limited experience with termites and with the methods of exterminating them, I believe that thorough periodic inspections should be made of all wood structures, especially those where untreated wood comes in contact with the ground. When there are indications that termites are at work, all such wood parts should, preferably, be removed, or, if impracticable because of the expense involved, thoroughly cleaned of wood that may be infested, and the ground, as well as the wood, be well saturated with creosote. By this method I believe the termite evil can be combated successfully.

President Bechtelheimer: We will now dismiss the committee with the thanks of the association.

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Bridge and Building Supply Men's Association Exhibit

October 15-17, 1940

Twenty-four manufacturers of equipment and materials used in the construction and maintenance of railway bridges, buildings and water service facilities, presented an exhibit of their products, under the auspices of the Bridge and Building Supply Men's Association, in connection with the forty-seventh annual convention of the association, the exhibit being held in the exhibition hall immediately adjacent to the convention room.

A list of exhibiting companies, together with the products on display, and the names of their representatives follows:

List of Exhibitors

Air Reduction Sales Company, New York—acetylene welding outfit; flame cleaning tip; electric welding unit—C. B. Armstrong, C. Daly, J. Kenefic, J. G. Magrath and E. F. Turner.

American Lumber & Treating Company, Chicago—samples of treated timber and illustrations of its use—Robert R. Clegg and R. B. Putman.

Armco Railroad Sales Company, Middletown, Ohio—samples of corrugated pipe and illustrations of applications—C. H. Anderson, R. Y. Barham, E. T. Cross and E. Harbeck.

Buda Company, Harvey, Ill.—earth drill; track and car jacks—R. M. Blackburn, H. H. Cohenour, J. S. Dempsey, R. B. Fisher, F. Gormley, W. A. Hart, R. K. Mangan, S. W. Sanford.

Celotex Corporation, Chicago—insulation; wallboard; cold storage insulation; interior finish—J. H. Bracken, W. S. Millener, W. G. Rogers and H. A. Winandy.

Dearborn Chemical Company, Chicago—rust preventives; sealing compound for wood water tanks; aluminum protective coating; pipe coating, wrappers for protection of underground pipe; chemical pumps; proportioner—Don Bishop, C. I. Loudenback, A. C. Moeller and C. C. Rausch.

Paul Dickinson, Inc., Chicago—roof ventilators; smoke jacks; stove jacks; roof drains; exhaust heads—A. J. Filkins, E. M. Filkins and William Harrison.

Joseph Dixon Crucible Company, Jersey City, N. J.—industrial paints—E. C. Bleam, R. E. Goodfriend and W. Skea.

Duff-Norton Manufacturing Company, Pittsburgh, Pa.—bridge jacks—C. N. Thulin and E. E. Thulin.

Homelite Corporation, Port Chester, N. Y.—portable pumps; generators and blowers—R. J. Edbrooke, R. C. McDonald and Nelson Thompson.

Johns-Manville Sales Corporation; New York—samples of asbestos-cement pipe; corrugated roofing and siding; asbestos roofing and siding shingles; conduit; asphalt tile flooring; asphalt shingles; built-up roofing; prepared roofing; pipe insulation; asbestos wainscoting and wall board; mechanical packing; asphalt plank—P. R. Austin, R. J. Offut, T. O'Leary, Jr., H. R. Poulson, W. W. Prosser, F. C. Vandervort and L. T. Youhn.

Lehon Company, Chicago—asphalt shingles; asbestos shingles; prepared and built-up roofing; aluminum paint; waterproofing materials—John Eipper, Tom Lehon, T. L. Kennedy, E. A. Leonard, R. J. Mulroney, John W. Shoop and Harry Wolfe.

Mall Tool Company, Chicago—gas-driven and electric-driven machines for

vibrating concrete and surfacing concrete, with attachments for grinding, pumping water, drilling, boring, driving lag screws, wire scratch brushing and sanding; pneumatic chain saws and cross-cut saws; electric saws, drills; grinders; and chain saws—Robert Burgwald, A. W. Mall, F. A. McGonigle, M. Rehnquist, M. S. Riley and James Stewart.

Massey Concrete Products Corporation, Chicago—literature on concrete pipe, piling, concrete cribbing and crossing slabs—Ross Clarke, David A. Hultgren and W. L. McDaniel.

Master Builders Company, Cleveland, Ohio—samples of floor wearing surfaces; rust joint iron; non-shrink aggregate for concrete bonds; reground portland cement paint for concrete surfaces; liquid quick-setting compound; water-reducing agent for mass concrete; membraneous curing compound; masterplate floors—L. W. Johnson, D. H. Lee and B. R. Wood.

National Lead Company, New York—red lead; white lead; linseed oil; colors in oil; lead mixing oil; literature on red lead paints and the use of white lead—Ralph Baker, W. S. Carlisle and Hugh M. Millen.

Oxweld Railroad Service Company, Chicago—flame cleaning apparatus; soldering and brazing outfit; complete welding and cutting outfit—Lem Adams, F. J. Duffie, F. Finsthwait, E. B. Hall, Jr., S. B. Hopkins, G. B. Moynahan and D. H. Pittman.

Patterson-Sargent Company, Chicago—bridge paints; and literature on bridge paint—Geo. W. Anderson, Ben Bowman and W. H. McBride.

Pocket List of Railroad Officials, New York—B. J. Wilson.

Railway Engineering and Maintenance, Chicago—copies of publication—G. E. Boyd, M. H. Dick, S. W. Hickey, N. D. Howard, E. T. Howson, C. W. Merriken, H. A. Morrison and J. S. Vreeland.

Ruberoid Company, Chicago—Geo. R. McVay.

Timber Engineering Company, Washington, D. C.—timber connectors; termite shields; and literature on connectors and timber design—J. B. Jordan and L. P. Keith.

U. S. Wind Engine & Pump Company, Batavia, Ill.—frost casing for riser pipes; tank stuffing box; float valves—C. E. Ward.

Warren Tool Corporation, Warren Ohio—claw bar—W. H. Bon, F. H. Lehman and Oscar Youngquist.

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	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Krausch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCloy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941
President	Armstrong Chinn	A.E.Bechtelheimer	H. M. Church
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove
2nd V.-Pres.	A.E.Bechtelheimer	H. M. Church	F. A. Soothill
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles
Sec.-Treas.	C. A. Lichty	C. A. Lichty	
Secretary			F. O. Whiteman
Treasurer			F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard
	W. R. Ganser	W. Walkden	L. G. Byrd
	F. H. Soothill	A. S. Krefting	K. L. Miner
	B. R. Meyers	A. M. Knowles	R. E. Caudle
	W. Walkden	L. G. Byrd	I. A. Moore
	A. S. Krefting	K. L. Miner	W. A. Sweet

LIST OF ANNUAL CONVENTIONS

No.	Place	Date	Membership	Enrollment
1	St. Louis, Mo.,	Sept. 25, 1891	60	...
2	Cincinnati, Ohio,	Oct. 18-19, 1892	112	24
3	Philadelphia, Pa.,	Oct. 17-19, 1893	128	27
4	Kansas City, Mo.,	Oct. 16-18, 1894	115	38
5	New Orleans, La.,	Oct. 15-16, 1895	122	40
6	Chicago, Ill.,	Oct. 20-22, 1896	140	36
7	Denver, Colo.,	Oct. 19-21, 1897	127	43
8	Richmond, Va.,	Oct. 18-19, 1898	148	34
9	Detroit, Mich.,	Oct. 17-18, 1899	148	32
10	St. Louis, Mo.,	Oct. 16-18, 1900	143	45
11	Atlanta, Ga.,	Oct. 15-17, 1901	171	46
12	Minneapolis, Minn.,	Oct. 21-23, 1902	195	52
13	Quebec, Canada,	Oct. 20-22, 1903	223	65
14	Chicago, Ill.,	Oct. 18-20, 1904	293	104
15	Pittsburgh, Pa.,	Oct. 17-19, 1905	313	62
16	Boston, Mass.,	Oct. 16-18, 1906	340	81
17	Milwaukee, Wis.,	Oct. 15-17, 1907	341	91
18	Washington, D. C.,	Oct. 20-22, 1908	368	99
19	Jacksonville, Fla.,	Oct. 19-21, 1909	393	79
20	Denver, Colo.,	Oct. 18-20, 1910	428	117
21	St. Louis, Mo.,	Oct. 17-19, 1911	499	102
22	Baltimore, Md.,	Oct. 15-17, 1912	524	103
23	Montreal, Que.,	Oct. 21-23, 1913	570	100
24	Los Angeles, Cal.,	Oct. 20-22, 1914	586	126
25	Detroit, Mich.,	Oct. 19-21, 1915	665	159
26	New Orleans, La.,	Oct. 17-19, 1916	710	154
27	Chicago, Ill.,	Oct. 16-18, 1917	704	168
28	Chicago, Ill.,	Oct. 15-17, 1918	716	119
29	Cleveland, O.,	Oct. 21-23, 1919	776	196
30	Atlanta, Ga.,	Oct. 26-28, 1920	840	172
31	New York, N. Y.,	Oct. 18-20, 1921	850	207
32	Cincinnati, Ohio,	Oct. 17-19, 1922	865	167
33	Seattle, Wash.,	Oct. 16-18, 1923	846	140
34	Kansas City, Mo.,	Oct. 21-23, 1924	837	202
35	Buffalo, N. Y.,	Oct. 20-22, 1925	759	172
36	Richmond, Va.,	Oct. 12-14, 1926	750	155
37	Minneapolis, Minn.,	Oct. 18-20, 1927	754	224
38	Boston, Mass.,	Oct. 23-25, 1928	755	211
39	New Orleans, La.,	Oct. 15-17, 1929	755	200
40	Louisville, Ky.,	Oct. 21-23, 1930	713	147
41	Chicago, Ill.,	Oct. 16-18, 1934	592	153
42	Chicago, Ill.,	Oct. 15-17, 1935	547	139
43	Chicago, Ill.	Oct. 20-22, 1936	588	129
44	Chicago, Ill.,	Oct. 19-21, 1937	566	147
45	Chicago, Ill.,	Oct. 18-20, 1938	589	139
46	Chicago, Ill.,	Oct. 17-19, 1939	546	145
47	Chicago, Ill.,	Oct. 15-17, 1940	610	167

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1. The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussions unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1. The membership of this association shall be divided into four classes, viz: Members, life members, associate and honorary members.

Section 2. A member shall be a person in a responsible position in connection with railway bridge and building work, or in the employ of a public regulatory body, a professor of engineering in a college, an engineering editor, or a government or private timber expert. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3. To be eligible for a life membership a member must have belonged to the association for at least ten years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of active membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2, of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of active members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8. Only active members shall hold office in this association, and only active and life members shall be entitled to vote in the election of officers or selection of place for holding annual convention.

ARTICLE IV.

OFFICERS

Section 1. The officers of this association shall be a president, four vice-presidents, a secretary, a treasurer and six directors who with the most recent past president shall constitute the executive committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members, shall be privileged to attend all meetings of the executive committee, of which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1. The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association but shall not have the power to render the association liable for any debt beyond the amount then in the treasury and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any active member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for reëlection.

Section 2.† The president, four vice-presidents, secretary and treasurer shall hold office for one year and the directors for two years, three directors

†Amended October 17, 1940.

being elected each year. All officers retain their offices until their successors are elected and installed.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears may be stricken from the list of members at the discretion of the executive committee.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1. Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing but may receive others into affiliate membership. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee of the asso-cation approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

BY-LAWS

TIME OF MEETING

1. The regular meeting of this association shall convene annually on the third Tuesday in October at 10 a. m.

PLACE OF MEETING

2. The place of holding the next annual convention shall be selected by ballot at the annual meeting of the association. All the places proposed shall be submitted to a ballot vote of the members present at the annual business session and the place receiving a majority of all votes cast shall b-

*Article adopted 1922.

†Amended October 17, 1940.

declared the location of the next annual meeting. If no place receives a majority of the votes cast, the place receiving the lowest number of votes shall be dropped on each subsequent ballot until a place is chosen.

3. It shall lie within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

DUES

5. The annual dues are $4 per year, payable in advance.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio member of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7. The vice-presidents in order of seniority shall preside at meetings in the absence of the president and discharge his duties in case of a vacancy in his office.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

NOMINATING COMMITTEE

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

10. After each annual meeting the president shall appoint a committee of five members, not officers of the association, of whom two at least shall be past presidents, and two of whom shall have served on the committee the previous year, which shall prepare a list of names of nominees for officers to be voted on at the next annual convention, in accordance with Article VI of the constitution, said list to be read at the first session of the second day of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

†Amended October 17, 1940.
‡Adopted October 17, 1940.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to coöperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Selection of place for next annual meeting.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions, motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise all discussions shall be governed by Robert's rules of order.

†Amended October 17, 1940.

DIRECTORY OF MEMBERS

Aagaard, P., Supt. of Bldg., I. C. R. R., Chicago (Retired).
Aaron, H. C., Insp. B. & B., W. M. Ry., Cumberland, Md.
Adkins, H. O., Mast. Carp., D. & R. G. W. R. R., Salt Lake City, Utah.
Ailes, N. C., 12 Adams Place, Delmar, N. Y.
Aldrich, L. G., Br. For., N. Y., N. H. & H. R. R., Harwich, Mass.
Alexander, L. B., M. C. R. R., Detroit, Mich.
Allen, F. W., Gen. Elec. For., N. Y. C. R. R., Albany, N. Y.
Allen, G. A., Br. Inspr., C. & O. Ry., Clifton Forge, Va.
Allen, T. H., Supv. B. & B., C. & O. Ry., Hinton, W. Va.
Anderson, August, Gen'l For. B. & B., L. S. & I. Ry., Marquette, Mich
Anderson, G. F.,For. B. & B., Sou. Pac. Co., Roseville, Cal.
Anderson, J. L., Supv. B. & B., M. P. R. R., Osawatomie, Kans.
Anderson, R. D., Div. Engr., C. & N. W. Ry., Huron, S. D.
Anderson, W. L., Dftsman, C. & N. W. Ry., Chicago.
Armstrong, F. A., Supv. B. & B., S. D. & A. Ry., San Diego, Cal.
Attix, U. S., Designer, Sou. Pac. Co., San Francisco, Cal.
Azer, Wm. J., Asst. Supv. B. & B., C. & N. W. Ry., West Chicago, Ill.

Baker, F. A., For. B. & B., Sou. Pac. Co., Springfield, Ore.
Baker, H. M., Supv. B. & B., Mo. Pac. R. R., Nevada, Mo.
Baker, R. C., Supv. Scales, C. & E. I. Ry., Danville, Ill.
Baker, W. L., Br. Inspr., C. & E. I. Ry., Salem, Ill.
Ball, H. H., Foreman, Can. Nat. Rys., Toronto, Ont.
Bardwell, R. C., Supt. W. S., C. & O. Ry., Richmond, Va.
Barnes, H. D., Auditor Cap. Exp., C. & N. W. Ry., Chicago.
Barr, H. L., Div. Engr., C. & N. W. Ry., Chadron, Neb.
Barrett, D. C., Div. Engr., C. & N. W. Ry., Norfolk, Neb.
Bartlett, J. F., Asst. Engr., C. & N. W. Ry., Escanaba, Mich.
Batey, W. A., System Brg. Insp., U. P. R. R., Omaha, Neb.
Bateman, S. E., For. W. S., Mo. Pac. R. R., Poplar Bluff, Mo.
Bauman, H. H., Trav. Br. Inspr., Erie R. R., Waldwick, N. J.
Bear, Maxfield, Ch. Conc. Insp., C. & N. W. Ry., Chicago.
Beaver, J. F., Trk. Supv., Southern Ry., Greenville, S. C.
Bechtelheimer, A. E., Asst. Brg. Engr., C. & N. W. Ry., Chicago.
Begeman, W. H., For. B. & B., Mo. Pac. R. R., Jefferson City, Mo.
Bender, Henry, C. & N. W Ry., Eagle Grove, Iowa.
Benjamin, H. I., V. Chm. Sys. Ins. Com., S. P. Co., San Francisco, Cal
Bennett, H. F., Asst. Mast. Carp., Erie R. R., Binghamton, N. Y.
Benson, G. W., Supv. B. & B., C. of Ga. Ry., Macon, Ga.
Berg, C. F., Dftsman, C. & N. W. Ry., Chicago.
Beringer, M. A., For. B. & B., I. C. R. R., Vicksburg, Miss.
Bird, H. F., B. & B. Insp., N. Y. C. R. R., Jersey Shore, Pa.
Bird, J. E., Asst. Supv. B. & B., N. Y. C. R. R., Corning, N Y.
Bird, W. D., G. F. B. & B., Santa Fe Ry., Albuquerque, N. M.
Bishop, H. T., Supv. B. & B., C. & O. Ry., Richmond, Va.
Black, R. J., Asst. Engr. Bldgs., P. M. Ry., Detroit, Mich.
Blewer, E. H., Chainman, N. Y. C. R. R., Albany, N. Y.
Boales, J. A., Gen. Brg. For., T. P. & W. R. R., Smithfield, Ill.
Boettcher, L. R., Asst. Engr., C. M. St. P. & P. R. R., Marion, Ia.
Bolmgren, E. W., Div. Engr., C. M. St. P. & P., LaCrosse, Wis.
Bost, M. A., Asst. Engr., C. M. St. P. & P. R. R., Mason City, Ia.
Botham, E. L., For. Brs., C. N. Rys., (C. Vt.) New London, Conn.
Bouton, C. A., B. & B. Inspr., N. Y. C. R. R., Ravena, N. Y.
Boyce, C. W., Supv. B. & B., Y. & M. V. R. R., Vicksburg, Miss.
Boyd, G. E., Asso. Ed., Ry. Eng. & Mtce., 105 W. Adams St., Chicago.
Bradish, H. G., Transitman, N. Y. C. R. R., Albany, N. Y.
Brandt, J. H., Supv. B. & B., C. & O. Ry., Columbus, O.
Bridgette, E. C., B. & B. Insp., Sou. Pac. Co., Los Angeles, Cal.
Brie, Fred, 2418 Casper Ave., Detroit, Mich.

Brion, O. L., Scale Insp., N. Y. C. R. R., Jersey Shore, Pa.
Brokaw, Van S., Asst. Eng., C. M. St. P. & P. R. R., Chicago.
Brown, E. H., Bldg. Supt., N. P. Ry., St. Paul, Minn.
Brown, Ira L., G. F. B. & B., A. T. & S. F. Ry., Arkansas City, Kan.
Buckingham, W., 907 Chittock Ave., Jackson, Mich.
Buckley, N., Br. Inspr., I. & G. N. R. R., Palestine, Tex.
Budd, Ralph, President, C. B. & Q. R. R., Chicago.
Budzenski, F. N., Asst. Supv. B. & B., C. & N. W. Ry., Antigo, Wis.
Buell, H. M., Brg. Insp., U. P. R. R., Omaha, Neb.
Bugg, J. H., Supv. W. S., C. N. Rys., London, Ont.
Bulger, J. M., Brg. For. B. & B., Sou. Pac. Co., Martinez, Calif.
Bunge, W. H., Bldg. Inspr., I. & G. N. R. R., Harlingen, Tex.
Burke, W. B., Supv. B. & B., N. Y. C. R. R., Albany, N. Y.
Burneson, A. W., For. B. & B., Mo. Pac. R. R., St. Louis, Mo.
Burns, R. T., Supv. W. S., C. & N. W. Ry., Boone, Iowa
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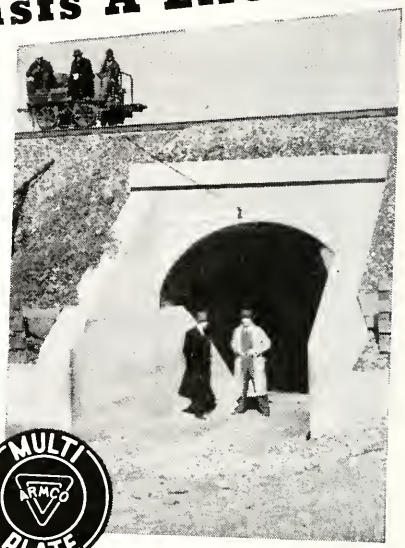

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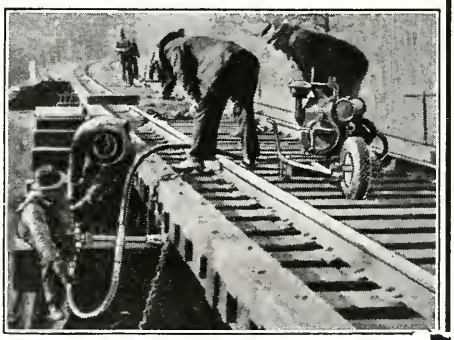

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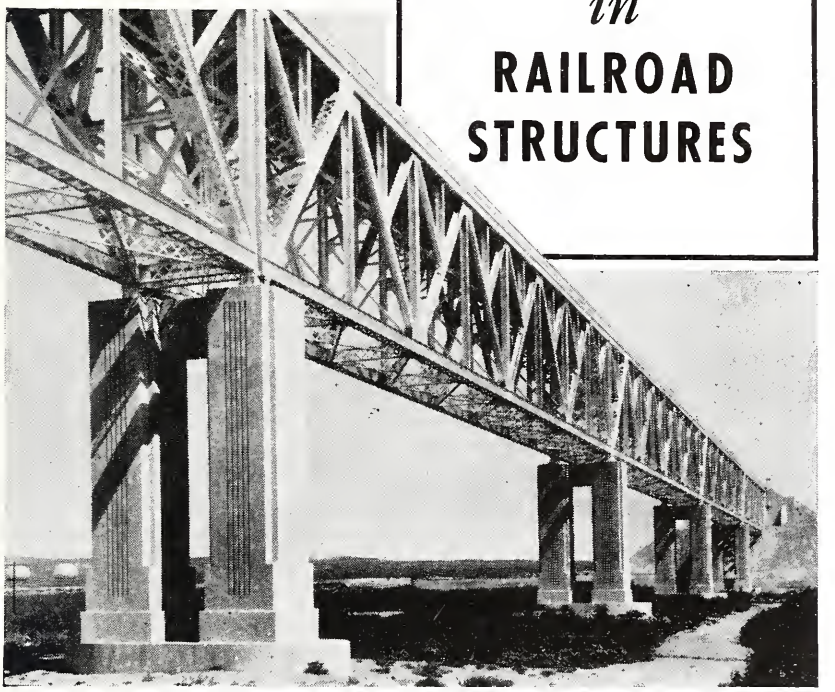

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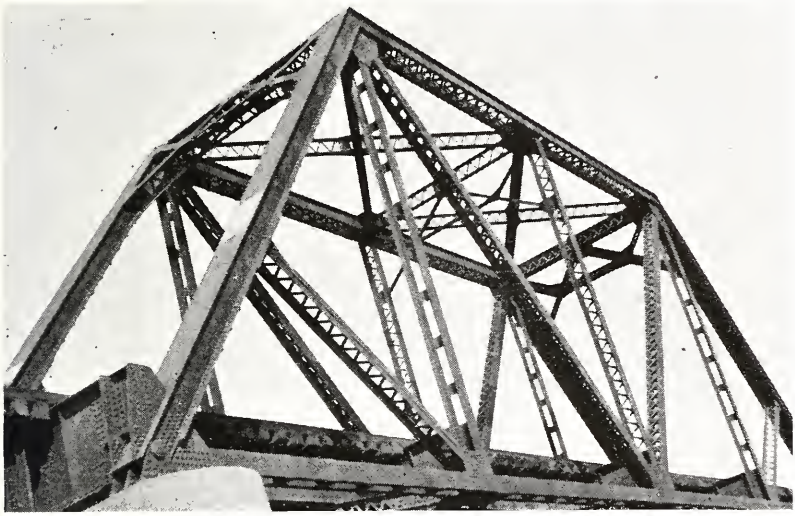

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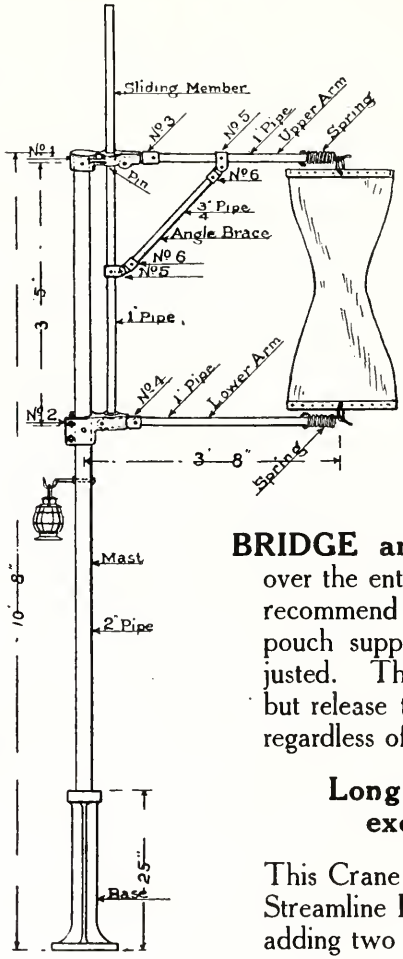

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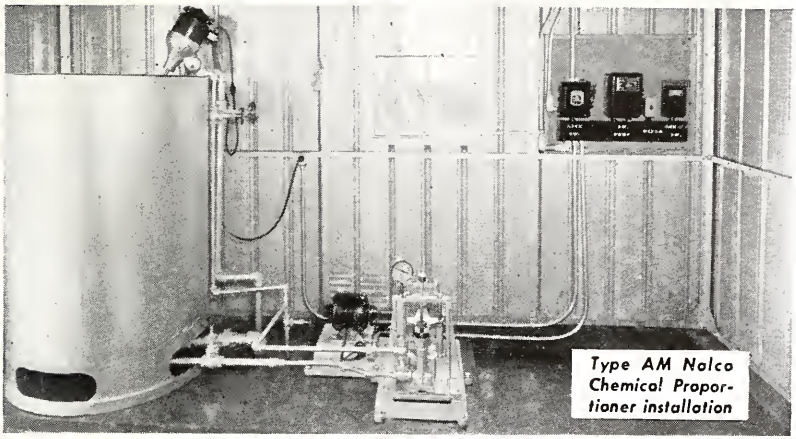
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The Oxweld Railroad Service Company has developed especially for railroads a portable double acetylene flood light.

THE Prest-O-Lite (Railroad Type) Acetylene Flood Lights for the WK acetylene cylinder are ideally suited to use with railroad work equipment, as well as on tunnel work, night construction, derailments, or emergency operations where a brilliant, dependable light is required.

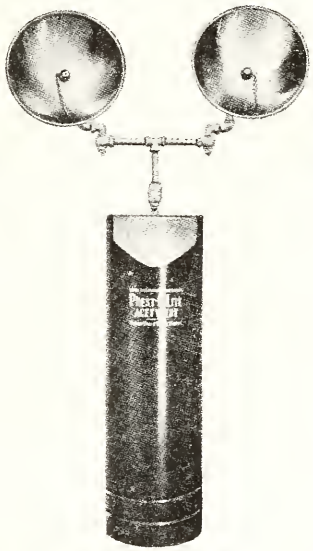
EFFICIENT ILLUMINATION — The single flood light produces a flood of clear, white light of about 4,000 candlepower, while the double flood light gives two flood beams of 4,000 candlepower which can be concentrated in one direction, or controlled independently. The light penetrates rain, steam, dust, fog and smoke to a remarkable degree. The 13-in., non-tarnishing, chromium-plated reflector gives a broad, even beam, strong at the sides as well as in the center. The burner is so designed that it is virtually impossible for any wind to blow out the flame.

EASE OF OPERATION — The flow of gas is easily controlled by the key-operated cylinder valve. In the single flood light, a swing joint permits vertical adjustment of the beam, while in the double flood light two swing joints for each reflector permit independent horizontal and vertical control of each beam.

CONVENIENT FUEL SUPPLY — These flood lights connect directly to WK cylinders of dry, freeze-proof Prest-O-Lite acetylene. Because these cylinders are a universally used source of acetylene for oxy-acetylene welding and cutting, they are readily available practically anywhere on the railroad at short notice.

STRONG CONSTRUCTION—These lights are sturdily constructed, and have been recently redesigned to reduce the number of parts to a minimum. Even a high wind cannot blow them over when they are in position for use on WK cylinders.

The Prest-O-Lite (Railroad Type) Acetylene Flood Lights are sold without the cylinder and may be obtained through The Oxweld Railroad Service Company.



The New Double Floodlight

The Improved Single Floodlight

THE OXWELD RAILROAD SERVICE COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

Chicago
Carbide and Carbon Bldg.

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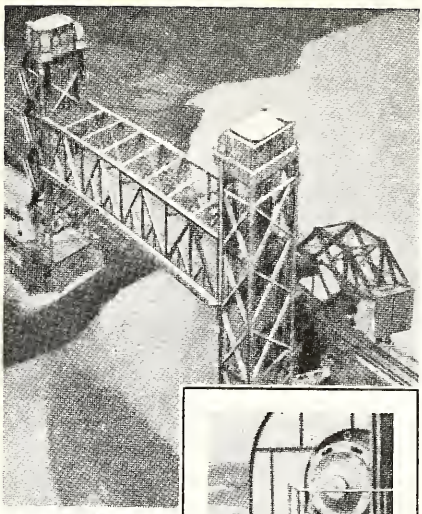
OXWELD RAILROAD SERVICE

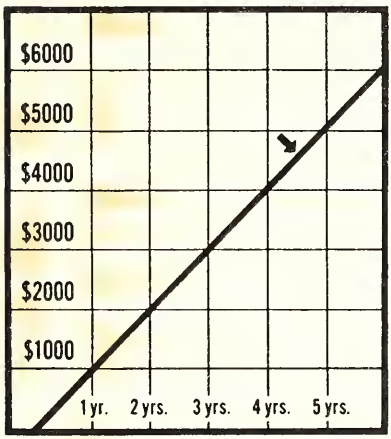
SINCE 1912—THE COMPLETE OXY-ACETYLENE SERVICE FOR AMERICAN RAILROADS

The word "Prest-O-Lite" is a registered trade-mark of a Unit of Union Carbide and Carbon Corporation

PLAN IN ADVANCE FOR *Operating Economy* ON VERTICAL-LIFT AND BASCULE BRIDGES



Chicago's Torrence Avenue Bridge and one of the 8 Bantam Bearing equipped million pound capacity sheaves on which it lifts.



For economical operation of movable bridges you must attack the problem while it is still in the blue print stage. Many successful bridge designers have wisely consulted Bantam Bearing Engineers at the outset.

The result may be seen in the accompanying graph which shows the actual power savings in one typical case. $4500 saved in power alone in 4½ years. In addition, there were big savings due to lowered lubrication costs and a considerable reduction in the size of operating motors and machinery.

When you plan new movable bridges, it will pay you to take advantage of our extensive bridge-bearing experience. We invite you to write or wire for real help in assuring bridge operating economy.

BANTAM BEARINGS CORPORATION
SOUTH BEND, INDIANA

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